FEBRUARY, 1917 PHOTO SUPPLEMENT NUMBER 15 CENTS

The Electrical Experimenter

POPULAR ELECTRICAL NEWS ILLUSTRATED

TRENCH DESTROYER

SEE PAGE 714

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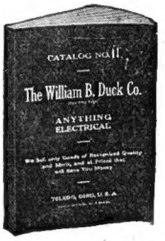

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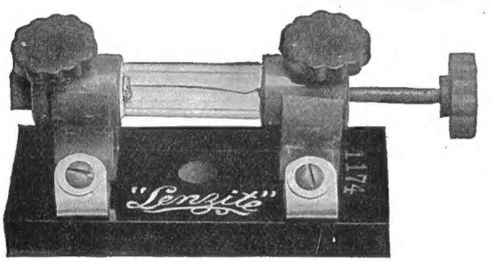

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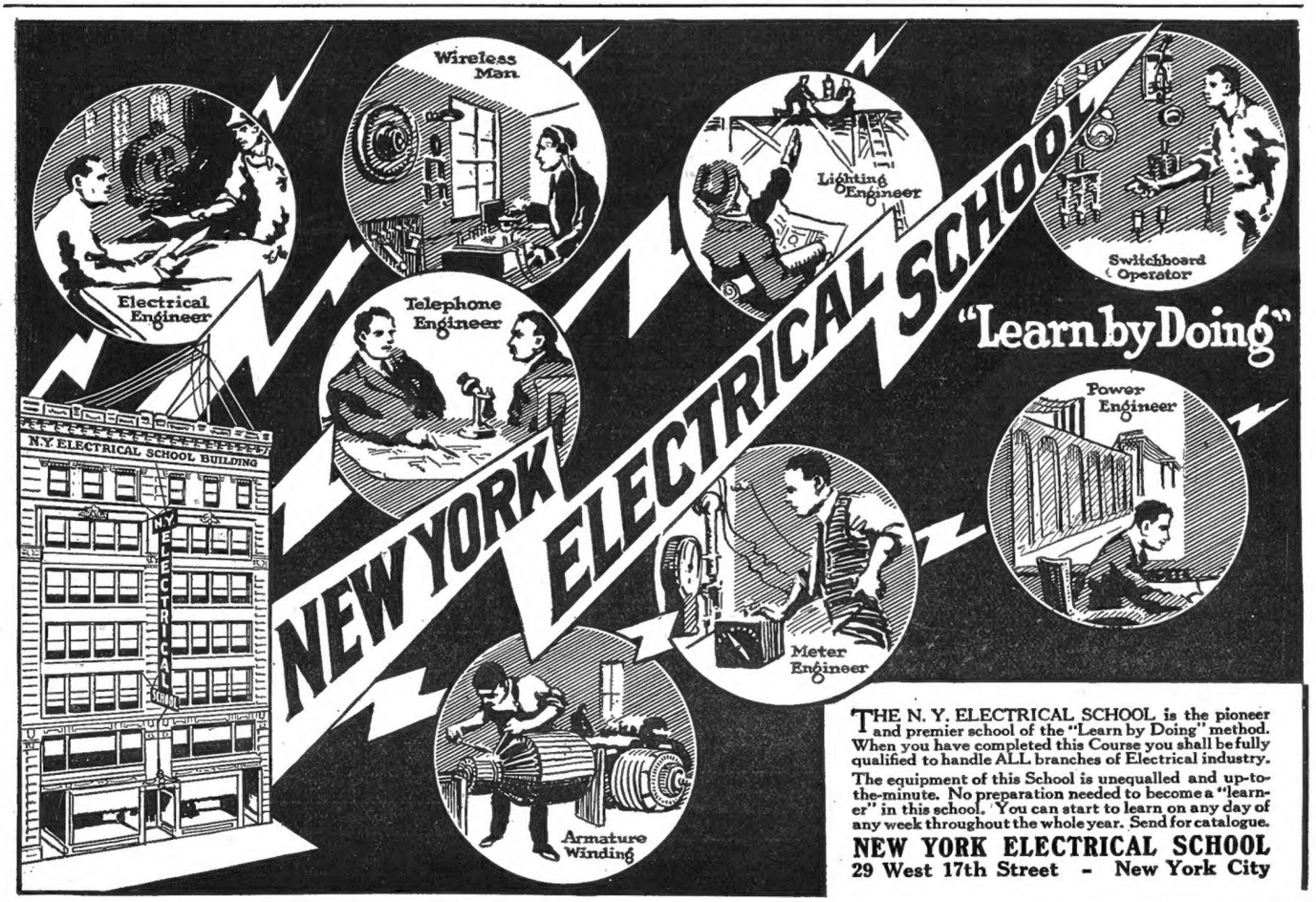

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Inventions Wanted

EVER since the publication of our May, 1916, issue, where we suggested a "list" of "What to Invent," we have been besieged by would-be inventors from all over the world, to publish another similar "list." From the many letters which reach the editor's desk every week, it would appear that there exists an unsatiated demand for practical ideas of this kind. While we are always glad to supply suggestions of this kind, a few words of advice to fortune-hunters via the Patent Office will not appear out of place.

The practical-minded inventor, as well as the one who has but a modest income, should always ask himself these important questions, before spending his money on models or patent fees:

1° Is the device useful? 2° Does it fill an actual want? 3° If so, is the device practical and can it be readily manufactured and marketed? 4° Is there a similar article on the market already?

Only if these questions have been answered satisfactorily to the inventor should he begin spending money on the device. Too many inventors are prone to rush to the Patent Office without asking themselves these all important questions, with the net result that out of one thousand patents issued by the U. S. Patent Office, less than three are ever taken up by a manufacturer, or are actually exploited by their inventors.

Then, again, far too many inventors are anything but practical-minded. Most of them lack business sense and for this reason every inventor should submit his idea to at least one trusted business friend, who is not intoxicated with enthusiasm, as is almost every inventor worthy of the name.

As to the suggestions we advance below, we believe that they cover all our requirements. There is a positive demand for all of the devices and if the correct solution is found, each invention will undoubtedly prove a handsome money maker.

ELECTRICAL AIR COOLER. At the present time we use fans in the summer to "cool" our sweltering humanity. Fans really don't cool, but simply stir up the heated atmosphere, and by causing drafts evaporate the moisture on our skins. This gives a cooling sensation. Electric fans, however, do not reduce the room temperature to any great extent and for that reason are makeshifts at best. We should produce COLD (lowering of the temperature) by some other electrical means. Peltier showed us that cold can be produced by crossing a bar of bismuth with a bar of antimony and sending an electric current thru it in a certain direction. This is Peltier's cross. Why cannot this principle—or a similar one—be supplied on a commercial scale, and incidentally make a fortune for its inventor?

ELECTRIC INSECT DESTROYER. Every summer we are exasperated by flies and mosquitoes. Why not keep them out of the house or kill them by some electrical means? Electrically charged wire netting has been used already, but it has many inherent faults. As a rule such netting cannot be used on windows as water or moisture puts the device out of order. Something more practical is required. Insects as a rule keep away from highly-charged conductors (high frequency or Tesla currents). Perhaps this hint will put somebody on the right track.

ELECTRIC TOYS. There is an immense market for cheap electric toys. Something is wanted to keep a boy amused with a good electric toy operated by a dry cell. Years ago we saw an electric motor that *sold for ten cents and actually ran.* It was badly designed and badly made, otherwise the five- and ten-cent stores would be selling a million or more of them a year. Here is a rich field and it matters little if the article can be marketed for ten cents or one dollar—if the toy is right.

ELECTRIC WINDOW ATTRACTIONS. A vast field for the clever inventor. Movable window attractions are in ever-growing demand. Everybody stops and looks at the least mystifying movable sign or whatnot. Electricity and magnetism supply unending combinations and providing the device is novel and cheap thousands can be sold. Every retail store can use one. Can you supply it?

BELL "SOFTENER." A poor title for want of a better one. The harassed modern business man is of late developing what is termed as the "telephone heart." Every time the 'phone rings he starts and if he is very nervous he jumps involuntarily. At home his wife is developing the same disease. What is wanted, badly wanted, is a device that will do away with the harsh, abrupt sound. Something "soft" and mellow that don't jar one's nerves, and at the same time is not too muffled, otherwise the calling signal cannot be heard in the next room. Simply unscrew the gongs and replace with your device. Can you furnish half a million at, say, $1.00 each?

H. GERNSBACK.

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All communications and contributions to this journal should be addressed to: Editor, THE ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York Unaccepted contributions cannot be returned unless full return postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

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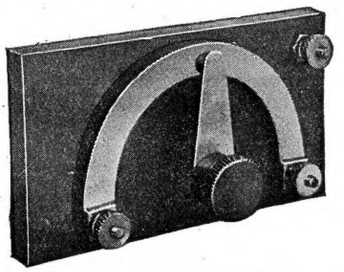

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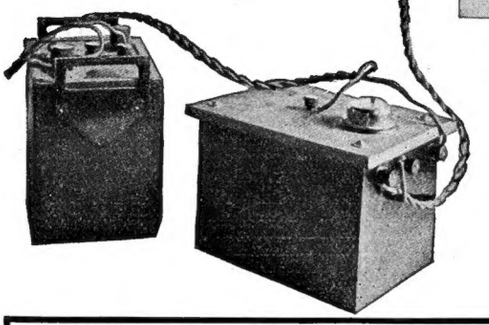

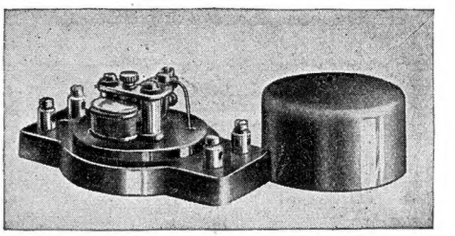

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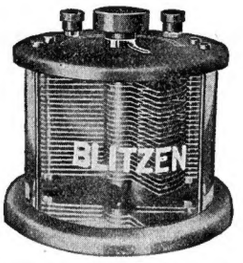

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Our small condensers, either 17 or 43 plates, are a little better value because a little better quality. Our catalog tells why.

ONLY A FEW

instruments selected from our new Catalogs can be shown here. Complete catalogs of Wireless and Electrical Apparatus, Storage Battery Chargers, Parts and Supplies sent for 6c stamps to defray postage.

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THE WIRELESS TELEPHONE

Do you realize that a thoroughly practical **Wireless Telephone** simple enough to be used by anyone has been produced?

A GREATER INVENTION THAN WIRELESS TELEGRAPHY

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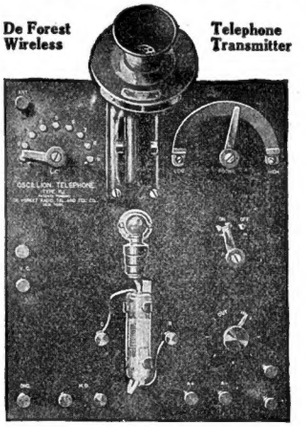

APPLICATIONS

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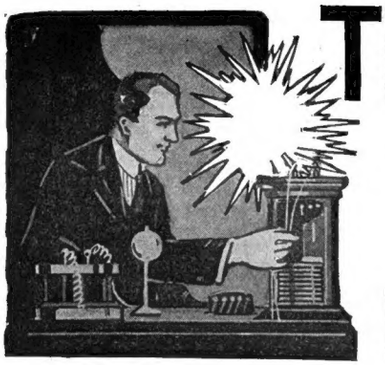


THE ELECTRICAL EXPERIMENTER

H. GERNSBACK EDITOR
H. W. SECOR ASSOCIATE EDITOR

Vol. IV. Whole No. 46 | FEBRUARY, 1917 | Number 10

An Electric Ripper and Igniter for Destroying Zeppelins

THE English aeroplane aviators are reported using a new and fearful death-dealing device with which to destroy Zeppelins, those much dreaded monsters of the air so favored by the Teutonic Allies.

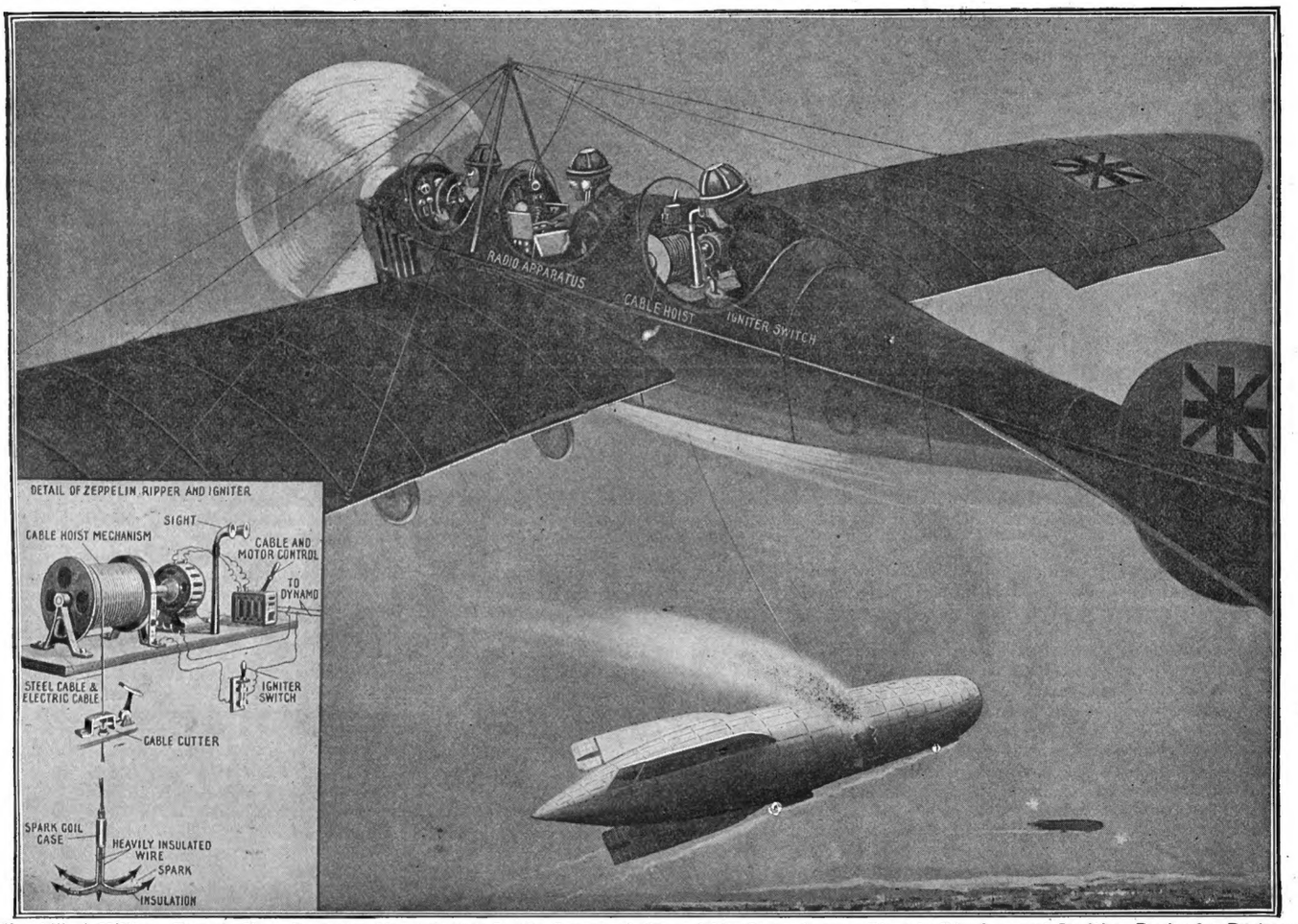
The accompanying illustration is a portrayal of such an attack on a Zeppelin by an enemy aeroplane fitted with this new electrically operated contrivance.

The attacking battle-plane carries, besides the aviator and radio operator, an operator who has charge of the electrical mechanism by which the double-pronged *ripping* anchor is lowered or raised to any desired level, as the 'plane soars thru the air above its prey.

At the psychological moment the officer in charge of the dependent *ripper* operates the proper switches, which cause the hook to rise or descend a sufficient amount to enable it to catch into the massive gas bag constituting the Zeppelin. As soon as the hook catches and begins to rip open the gas bag the officer in the aeroplane throws in the igniter switch which sends an electric current instantaneously down the supporting cable attached to the ripper hook and this current, passing thru an intensifying or spark coil mounted on the hook, produces a powerful spark several inches long between the insulated prongs, which ignites the gas. This spells the beginning of the end for the air-cruiser. And it is said that one of the most powerful and mastodonic Zeppelin craft ever launched by the Austro-German forces was recently dispatched earthward in England by this means.

In this particular case, wherein the electrical ripper and igniter described proved successful, the English aviators had sufficient notice ahead of time, so that they could rise to a sufficient height in order to make a swooping attack on the dirigible.

The exploding device, resembling that shown in the accompanying illustration was, after several trials, drawn successfully across the envelope, ripping it open, so that the liberated gas could be fired by the spark. Such an invention would seem practical if used by expert military aviators, as the aeroplane can sail circles around the fastest Zeppelin. Moreover, it is a record of actual fact that once a Zeppelin is aflame there is practically not one chance in ten thousand of its recovering.



The Allies' Military Experts Have Devised a New Thriller In the Drama of War. This Comprises an Electric Ripping and Igniting Device for Destroying Zeppelins, and Which Can Be Manipulated From a Battle-plane In the Manner Shown.

Lighting the Statue of Liberty

The illumination of the Statue of Liberty on a scale commensurate with its importance as America's most famous monument may be regarded as the climax of three years' effort and development in the art of flood-lighting.

H. H. Magdsick, who conceived the idea, was graduated from the University of Wisconsin and since then has been connected with the Engineering Department of the National Lamp Works of General Electric Company.

The electrical press aided the enterprise and so much progress was made that it was decided to inaugurate the permanent flood-lighting on Saturday, December second. The occasion was one of vast splendor as seen from the photograph. Miss Ruth Law, in her illuminated aeroplane, circled the Statue, the words "LIBERTY" appearing in electric lights on the planes while she released a string of magnesium bombs. The flash across the sky and light spirals at the right were made by Miss Law's machine. A squadron of electrically decorated battleships flashed their powerful searchlights on the Statue, while President Wilson and other notables including the French Ambassador and Mayor Mitchel of New York City, viewed the proceedings.

Magnificent Display at Initial Flood-lighting of Statue of Liberty, when Miss Ruth Law Circled the Statue in Her Electrically Illuminated Aeroplane, from Which She Liberated Magnesium Fire Bombs.

That no detail in the artistic conceptions of Bartholdi might be disturbed in transforming this dull lantern into a flaming torch effect, Gutzon Borglum, who breathes Bartholdi's genius, was engaged to supervise this artistic remodelling.

When the restored torch flame was completed, all the bronze plates were cut out leaving as a skeleton, rivetted lines about an inch in width. These plates were then used to construct moulds upon which pieces of glass were bent. These pieces of glass, when fitted into the place substituted for the bronze torch, a glass torch held together by the same rivetted lines.

In selecting the glass, Mr. Borglum picked out three tones of yellow cathedral glass. A dull surface was preferred to avoid the blinding noon-day glare of a rich reflective surface. The lightest tint was used to simulate the tip of the flame, with slightly darker pieces inserted here and there variously down to the base of the flame, where the darkest of the tints still define the lines of the bronze of the torch against the glass of the flame.

To mould 600 pieces of glass, each piece being bent to an individual template, was a task calling for minute exactness, for each template had to be made so perfect that the complete glass substitution would be water tight. The 600 pieces of glass average about one foot square, making a complete glass area in the torch of some 600 square feet.

This substitution of 600 square feet of bronze with a similar area of three tinted glass and the novel method of its installation establish an innovation in modern glazing. Yet, the most interesting, perhaps, of the many illuminating novelties incorporated into the new Statue is the lighthouse lens in the torch. The lens alone cost $450.00. It is known as a fifth order lighthouse lens 9½ inches in diameter and 15 inches deep. The lens will be supported at a height so that the light will spill out in parallel lines with the height of the glass of the torch. This will contain about 20,000 candle-power.

Finally to put *life* or a quiver into the simulated flame of the burning torch, about fifteen 500 candle-power gas-filled electric lamps will be placed upon a series of flashers. The flasher will not be set to certain revolutions, the experts preferring to allow the flasher to carry out the unsteady but constant flicker and blaze of the flaming torch.

Thus Mr. Magdsick has succeeded in getting a variable light similar to that of a flame while maintaining a steady light, by means of the lens. The two forms of light simulate exactly and faithfully the flicker and the constant glow of the burning torch.

The sources of the flood lights are fifteen batteries of projectors. Eleven of these batteries are located upon the eleven salients of the old Fort, known as Fort Wood, upon which the base of the Statue was built. Three batteries are located upon the roofs of small buildings on the Island. The other battery is located upon the balconies of Liberty's arm, just below the torch.

The total number of projectors is 246, each being 250 watts. The lamps are 35 volt lamps, each of the 246 projectors having its individual compensator to step down the 220 volt current to the lamp voltage. The projectors and compensators are mounted on specially designed pipe-framed circuits, individually designed for the different locations.

The Public Service Corporation of New Jersey supplies the 2,200 volt two-phase current from its Marion Station through its Garfield Avenue sub-station. This current is carried by submarine cables under the channel between New Jersey and Bedloe's Island up to the old Government power house upon the Island.

In the power house this current is stept down to 220 volts, the current then being carried through underground cables to the base of the Statue and from that point through suitable manholes.

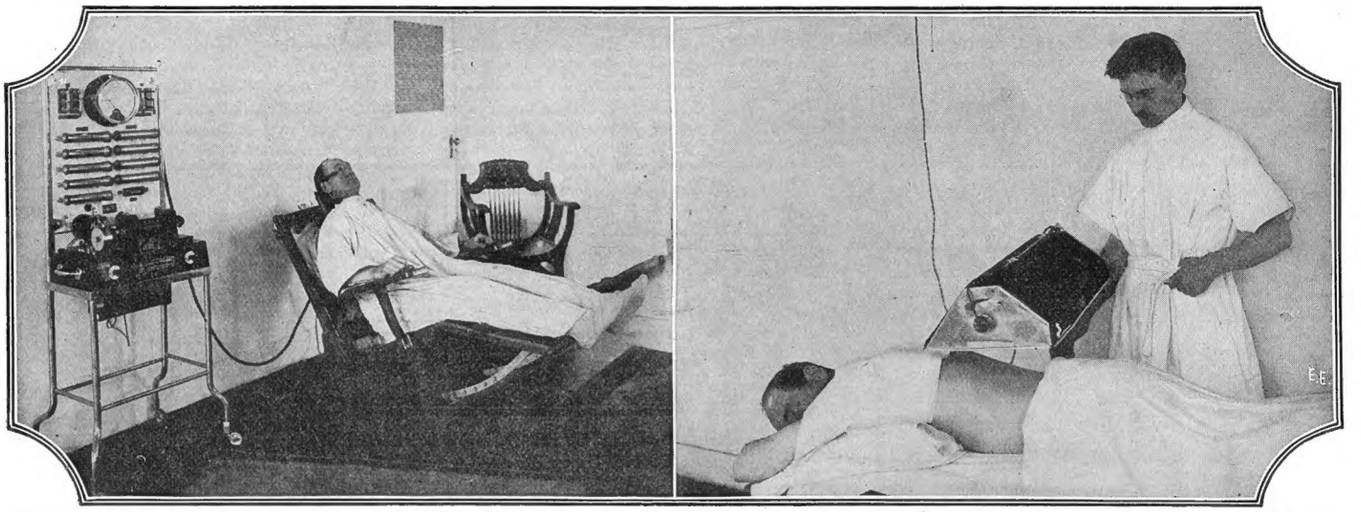
H. H. Magdsick, the engineer who built the Statue of Liberty lighting plant, told the members of the New York Electrical Society at a meeting held in Post Hall, on Bedloe's Island, how the problem had been worked out. He explained that the Statue reflected only about 6 or 7 per cent of the light which the reflectors grouped about it, as only 30 per cent of the light sent cut from the reflectors reached the Statue, about 25 per cent of that being reflected back by the Statue.

DATE OF ISSUE.—*As many of our readers have recently become unduly agitated as to when they could obtain* THE ELECTRICAL EXPERIMENTER, *we wish to state that the newsstands have the journal on sale between the fifteenth and the eighteenth of the month in the eastern part of the United States and about the twentieth of the month west of the Mississippi River. Our subscribers should be in possession of their copies at these dates. Kindly bear in mind, however, that publications are not handled with the same dispatch by the Post Office as a letter. For this reason delays are frequent, therefore kindly be patient and do not send us complaints as to non-arrival of your copy before the twenty-fifth of the month.*

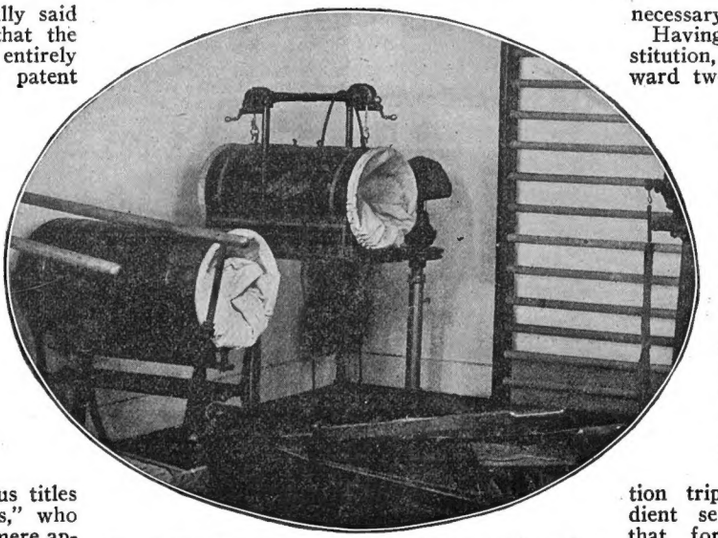
Electricity, the Wonder Doctor of the Age

DOCTORS have been an all-important factor in the health of the world's communities for many ages and never more so than to-day. But there are different ways of treating the sick, the lame and the ailing. It has been truthfully said by more than one authority, that the average person of to-day takes entirely too much medicine, especially patent medicines. Pathological or medicinal chemistry is a wonderful and blessed science without a doubt—but there are many ailments of the human body—some of them even called incurable by the general practitioner—which will, and have, yielded to other treatment than that involving the ofttimes undesirable dosing with powerful medicines.

The author must confess that he has always maintained a profound respect for the man of medicine. Yes—even to the entire exclusion of that rapidly growing class of Twentieth Century specialists who parade under a host of multifarious titles ranging from "magnetic healers," who claim to cure everything by the mere application of their powerful *magnetic* hands, up to the doctor of some new-fangled *ism* or *practic*. But as pride goeth before a fall—so were my mental deductions in this direction about to receive a heavy jolt. I had heard at difftrent times of a wonderful new institution in New York City where all kinds of human disorders were treated by marvelous electrical machines, and more—that they were invariably cured! I determined to visit this electrified hospital and accordingly made the necessary arrangements for a visit.



Electricity Being Used in Fat Reduction (Left) While Patient Reclines on Special Chair. Sand Bags Are Placed on the Body. The "Dowsing" Radiant Heat and Light Treatment (Right) for Muscular and Other Disorders.



Electric Bake Ovens for Treating Such Human Ills as Gout, Stiff Joints, Wounds, Rheumatism, and Other Ailments with 400° Fah. "Dry Air."

Having arrived at this far-famed institution, your author was whirled skyward twenty stories in less time than it takes to tell it. Stepping off the elevator a pleasant attendant, attired in white, greets prospective patients and if they do not carry detailed instructions as to the exact electrical or other treatment they are to receive, then they are ushered into the doctor's office for consultation. Really, one can hardly feel sick or ailing in this wonderland of spick and span private treatment rooms and corridors — all flooded with sunlight thru large skylights in the roof. Uniformed nurses flit about noiselessly and precisely.

We started on our inspection trip—the doctor and your obedient servant—ye scribe. He stated that for nineteen years they have been successfully treating all sorts of

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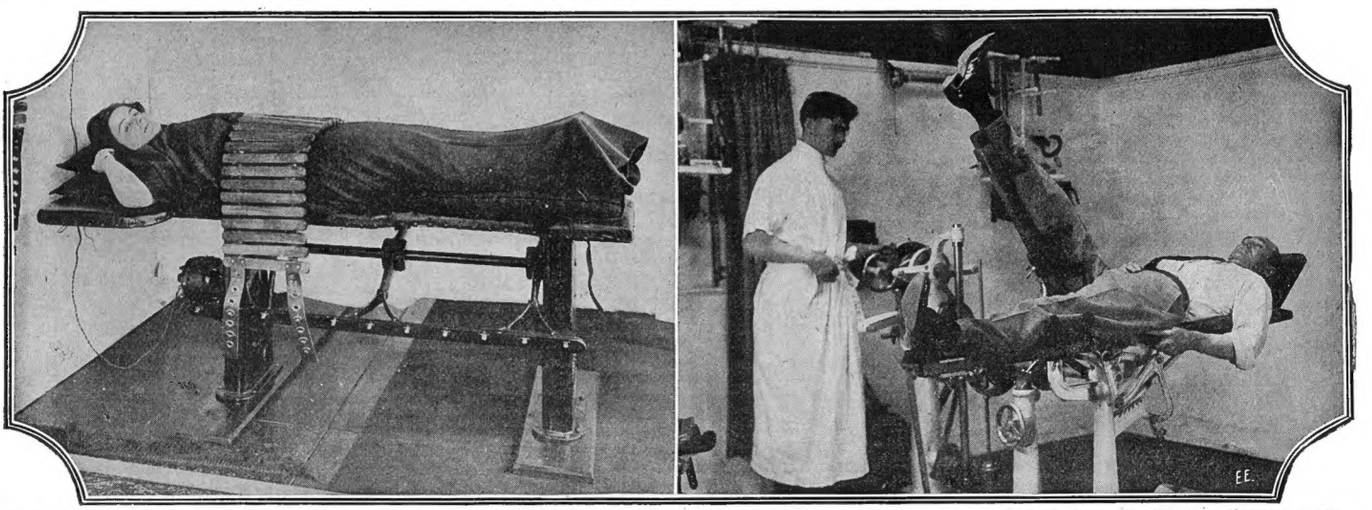
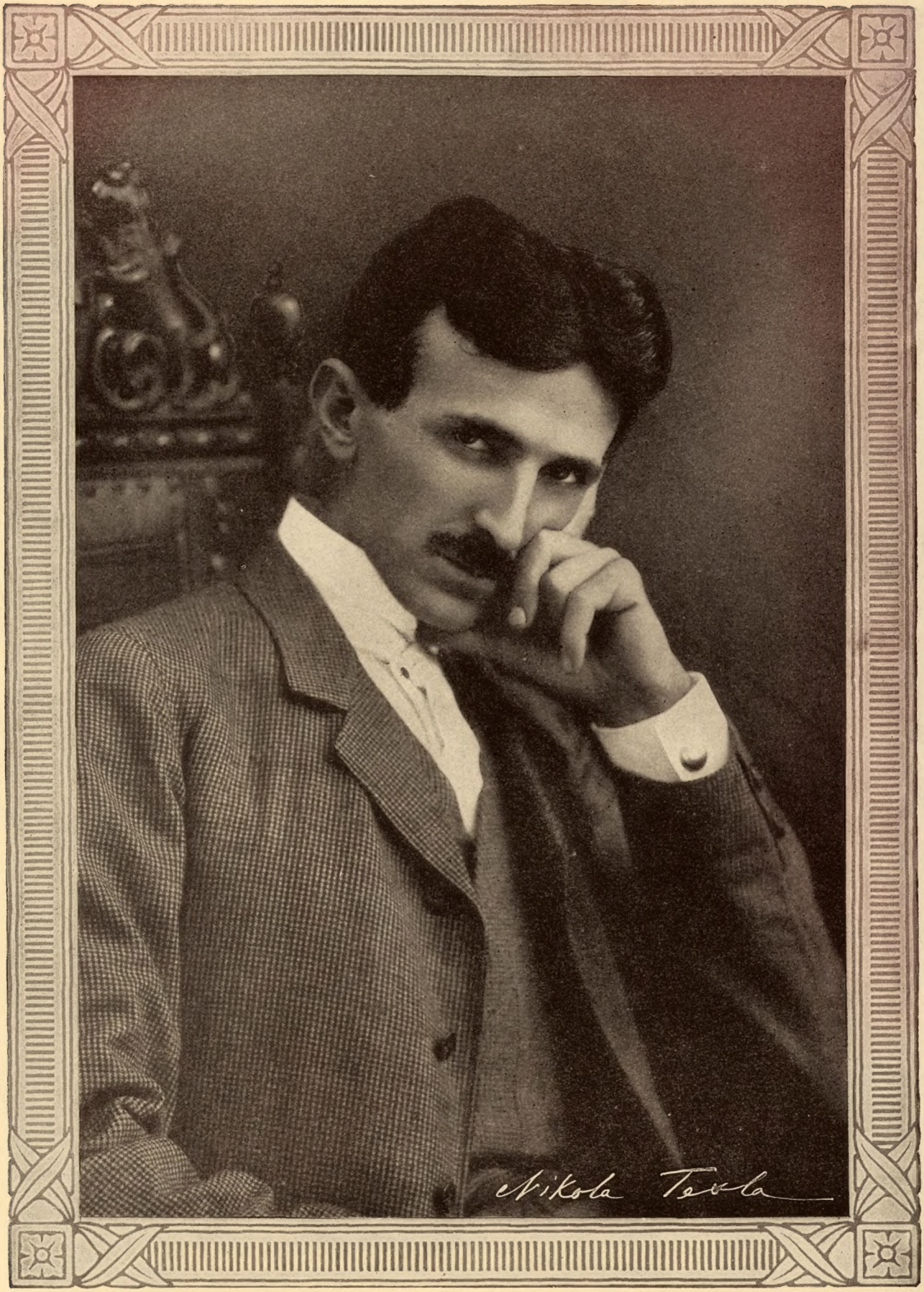


Obesity Reduction (Left) by the Electrically Driven "Niles Normalizer," Which Pulls the Wooden Bars To and Fro' Over the Body. (Right) Stiff or Rheumatic Joints Being Limbered Up on the Wonderful Electric "Arthromotor," a Swiss Invention.



Supplement to The Electrical Experimenter February 1917

Dr. Nikola Tesla and His Achievements*

By SAMUEL COHEN

PERHAPS the ever-broadening field of invention has never known a genius more successful in developing far-reaching and original inventions than Dr. Nikola Tesla, whose name is known in every corner of the globe for his scientific achievements.

Dr. Tesla was born in 1857 in Smiljan, Lika, border country of Austria-Hungary, His early education was obtained in the elementary school of his native place. He continued his studies in the public school in Gospic, Lika, and after spending a period of four years in the Lower Real School in Groatia, he graduated in 1873.

His parents originally desired him to study for the clergy, which can be readily understood when one considers that Dr. Tesla's father was himself a very noted clergyman and orator. However, young Tesla had his mind set on mathematics and physics, and after prevailing upon his parents for permission to study engineering, he entered the Polytechnic School at Gratz, where for four years he studied mathematics, physics and mechanics, after which followed a two year course in philosophic studies at the University of Prague, Bohemia. His practical career started in 1881 in Budapest, Hungary, where he made his *first* electrical invention, a *telephone repeater*—and conceived the idea of the *rotating magnetic field*, which later made him world famous. It may not be amiss to devote a few moments here to the manner in which this prince of savants approached the idea of the rotating field and *induction motor*.

One day while attending the University, one of the Professors was demonstrating an experiment with the Gramme armature type of dynamo, when the idea occurred to the young physicist that the sparking at the commutator, which he alone had minutely observed, could be eliminated. The professor immediately denied that this was possible, but with a steady mind and self-conviction, young Tesla determined to work out his ideas, with the result that the modern induction motor was developed, which operates solely from alternating current and requires no commutator of any kind, thus overcoming the nuisance of sparking inherent in former type direct current machines.

Realizing the value of his invention he left for France in an effort to interest some one in his device, but his efforts proved fruitless. At the time he was employed by a prominent European engineering concern, but hearing of the rapid growth of the electrical industry in America, he promptly decided to come to this country, which he did in 1884, and since then has been a naturalized citizen of the United States. To this country he brought with him the various models of the first induction motors, which were eventually shown to George Westinghouse, the great American inventor, and it was in the Westinghouse shops that the induction motor was perfected by Nikola Tesla. Numerous patents were taken out on this phenomenal prime-mover, all of which are under Dr. Tesla's name, and he was therefore the first person, beyond the shadow of a doubt, to introduce the rotating field principle, in perfecting the induction motor, which is to-day universally used.

Fig. 1 shows the first induction motor, and altho unique in construction, it developed ¼ horse power at 1800 revolutions per minute and weighed but 20 pounds.

Large sums of money were expended by Dr. Tesla to protect his patents on this prime-mover, and he was at the time not permitted to express himself in print or give the history of his invention; thus, many erroneous impressions were entertained regarding his inventions. He was far ahead of Ferraris, Schallenberger and

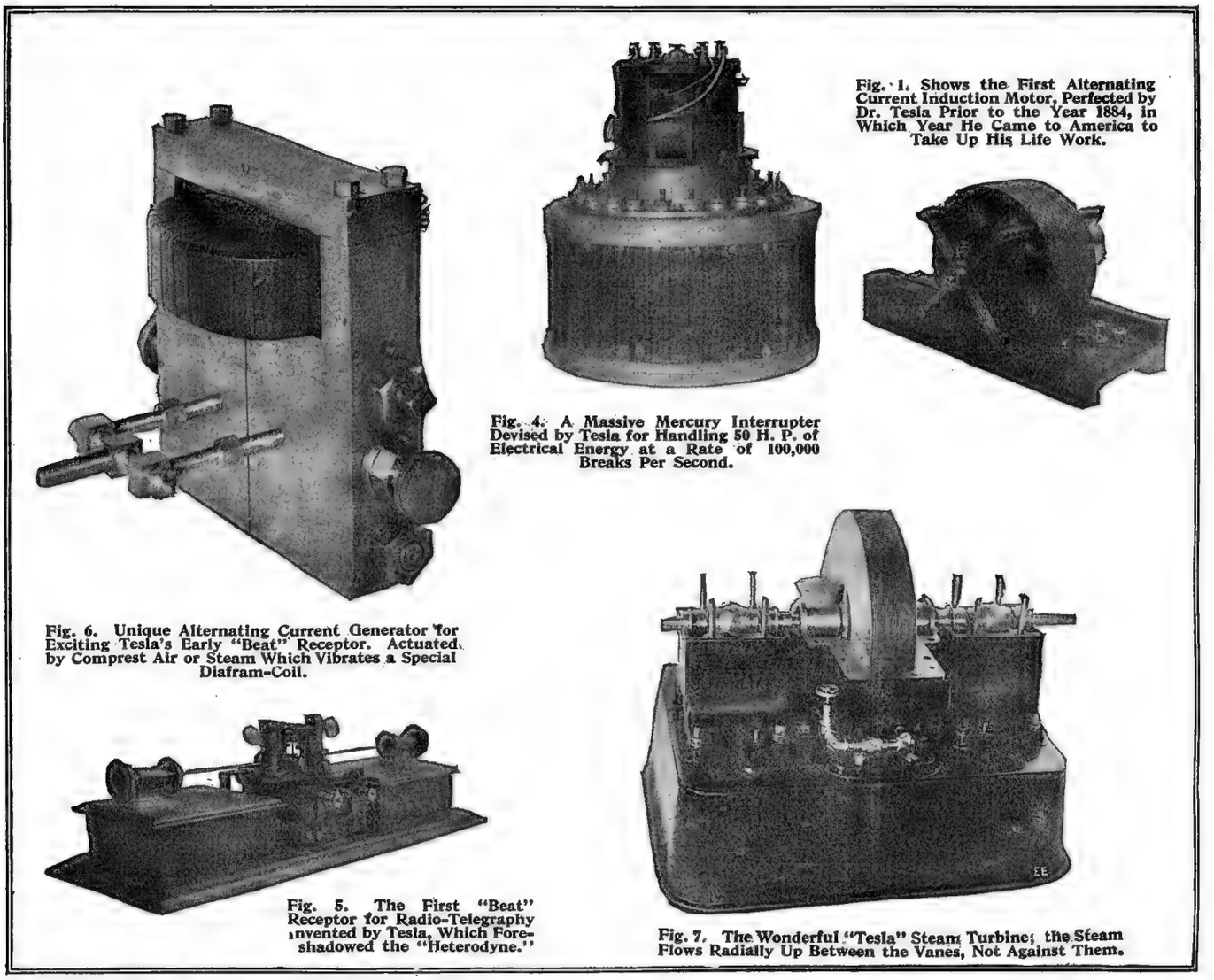


Fig. 1. Shows the First Alternating Current Induction Motor, Perfected by Dr. Tesla Prior to the Year 1884, in Which Year He Came to America to Take Up His Life Work.

Fig. 4. A Massive Mercury Interrupter Devised by Tesla for Handling 50 H. P. of Electrical Energy at a Rate of 100,000 Breaks Per Second.

Fig. 6. Unique Alternating Current Generator for Exciting Tesla's Early "Beat" Receptor. Actuated by Comprest Air or Steam Which Vibrates a Special Diafram-Coil.

Fig. 5. The First "Beat" Receptor for Radio-Telegraphy Invented by Tesla, Which Foreshadowed the "Heterodyne."

Fig. 7. The Wonderful "Tesla" Steam Turbine; the Steam Flows Radially Up Between the Vanes, Not Against Them.

*Special interview exclusively for THE ELECTRICAL EXPERIMENTER.

many other early, able investigators.

Later another type of machine was brought out by him, in connection with his work in electric power transmission. This one had a field energized by currents of different phase relation (i.e., while one current was at zero amplitude the other would be at maximum, etc.), producing a rotating field in which conductors were employed, and in this way the high frequency current was obtained. This type of machine was subsequently developed by Goldschmidt and is now known under that name, altho Tesla described this principle in a patent dated 1889.

His next work which attracted universal attention was the production of high frequency currents at high potentials. Our readers are no doubt familiar with the tremendous electrical discharges which have been illustrated in several of the previous issues of THE ELECTRICAL EXPERIMENTER. All these experiments were first performed by this genius and never duplicated. One of the first high tension apparatus built by Dr. Tesla is shown in Fig. 2. Incidentally we might mention that this instrument was first used in Europe by Lord Kelvin, the noted English mathematician and scientist, who used it for his lecture demonstrations at the Royal Society. The apparatus consists of a step-up transformer, and a specially built kick-coil, which boosted the secondary transformer voltage to an enormous value. This coil is seen resting horizontally at the back. The terminals of this coil are connected to the large spark gap, which, when the apparatus was excited, was filled with a spark two feet long. The high tension condenser is inclosed within the cabinet. The large coil is used as kick-coil for increasing the voltage. With this device Dr. Tesla was able to obtain a potential of one million volts, which is quite extraordinary with such small apparatus.

Dr. Tesla can rightfully claim priority in employing *conical coils* for high frequency work, as Fig. 3 shows the first conical coil ever employed for such work, as early as 1892. This coil was excited by means of a powerful transformer. The discharger consisted of a multiple gap, commonly called to-day the quenched gap, which will be noted at the left of the huge coil. An interesting feature of this coil is that a finer wire winding is used at the upper end so as to increase the voltage at that point.

The machine in the foreground is a *50,000 volt direct current dynamo,* which was employed in many of his experiments on high potential electricity. In conjunction with the experiments on high voltage *direct current,* Dr. Tesla developed numerous interrupters for breaking these tremendous currents, the largest one ever built being that shown in Fig. 4. This massive circuit-breaker handled with great ease 50 horse-power of electrical energy at an interruption rate of 100,000 breaks per second. The interrupter consisted of a large chamber in which a circular suction cog was placed, driven at tremendous speed by a motor stationed on top. The rotor or cog operated in a column of mercury in such a manner that each stud of the cog made contact with the pool of mercury, thus making and breaking the electrical circuit. Dr. Tesla employed this interrupter for his wireless researches in 1900.

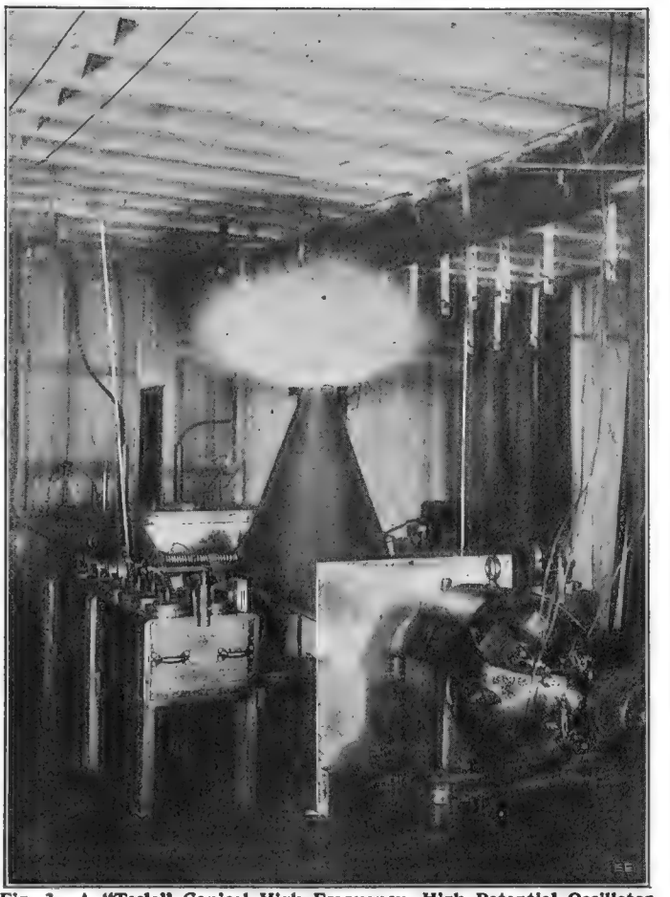


Fig. 3. A "Tesla" Conical High Frequency, High Potential Oscillator Coil Delivering a Very Powerful Discharge Several Feet in Diameter. The Condensers May Be Seen at Right and Left of Coil, as Well as 50,000 Volt D. C. Dynamo in Foreground.

Dr. Tesla's most important work at the end of the nineteenth century was his original system of *transmission of energy by wireless.* In 1900 Tesla obtained his two fundamental patents on the transmission of true wireless energy covering both methods and apparatus and involving the use of four tuned circuits. He also obtained a number of other patents at the same time, describing many other improvements. Among these may be mentioned his application of refrigeration and the oscillatory systems with which he obtained remarkable results in his well-equipt laboratory on Houston Street, New York City.

In 1901 and 1902 several patents were granted to him describing a number of improvements, among which two have assumed great importance in the radio art; one of these is known under the name of the "tone wheel" and the other the "tikker." Others are making claim to these inventions, but Tesla was far ahead of any of them.

At a little later date Tesla secured two patents on what he termed the *principle of individualization,* involving the use of more than one oscillation for the operation of the receiver This property is now known under the commercial name of *beat* receptors. In long protracted interference proceedings carried on in 1903, however, Tesla has been accorded full and undisputed priority over Fessenden and other claimants. His first *beat* receiver is shown in Fig. 5, which consisted of a steel band stretched above a powerful electro-magnet excited by a high frequency current, causing the steel band to vibrate at an enormous rate. A small sensitive electro-magnet is placed in proximity to the band, in which is produced an alternating e.m.f., and this is acted upon by the received wave.

The apparatus is timed by adjusting the periodicity of the band until the received wave is made audible. The large electro-magnet was usually excited by means of an alternating current generator, and this is illustrated in Fig. 6. Like all Tesla inventions, the construction of this oscillator is very unique, consisting of two chambers in the center of which is placed a vibrating membrane. This is inclosed in a magnetic field, consisting of a powerful coil encircling the device as seen and which was excited by a direct current. The membrane was caused to vibrate by passing interrupted, comprest air thru the two chambers by the inlet pipes as indicated. In the process of vibration, an e.m.f. is produced in a coil secured to the vibrating disc.

A patent was granted to Dr. Tesla in 1914 on an improvement of far-reaching importance in wireless work. The application was filed in 1902. It describes a new form of transmitter with which, according to Tesla's statement, an unlimited quantity of energy can be transmitted from a small and compact plant. This transmitter possesses the wonderful feature whereby *static*—the one nuisance of the radio art, and any other interference can be completely eliminated, because of the speed with which the receivers can be

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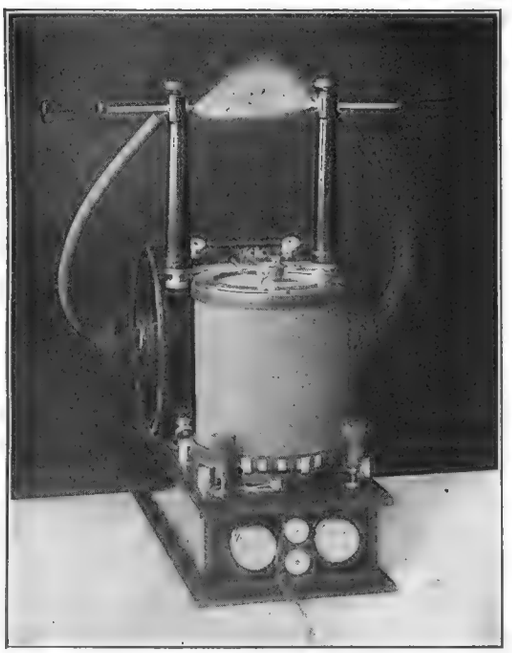


Fig. 2. An Early "Tesla" High Frequency Developing 2 Sq. Ft. of Streamers With 25 Watts Input. First Used in Europe by the Late Lord Kelvin in His Lectures Before the British Association for the Advancement of Science.

The Trench Destroyer

By H. GERNSBACK

IN the February, 1916, issue of this journal, the author described a formidable war machine, termed the *"Trench Tractor."* This machine was conceived primarily to force a breach in an existing, well defended trench. Once across the trench, the infantry could force its way thru and then perhaps attack another portion of the trench from the rear, conditions being favorable. As will be remembered, the Trench Tractor was no mere bagatelle, it measuring 140 feet from wheel to wheel, while the tractor wheels themselves were over 40 feet high.

On account of its novelty, the Trench Tractor enjoyed a remarkable publicity. Several hundred American papers and a score of European journals described and discust it, and now, a year after its description in THE ELECTRICAL EXPERIMENTER, it pops up every once in a while. Whether the Trench Tractor will ever be constructed, matters very little; what is more important tho, is that it has set many able people to thinking.

Imitations and *improvements* on the original design have not been lacking, the latest appearing in a New York Scientific Journal as described by one Frank Shuman.

He simply takes the Trench Tractor and enlarges it three or four times. He then added a superfluous third end wheel *for steering purposes,* and palms it off as a brand-new war machine.

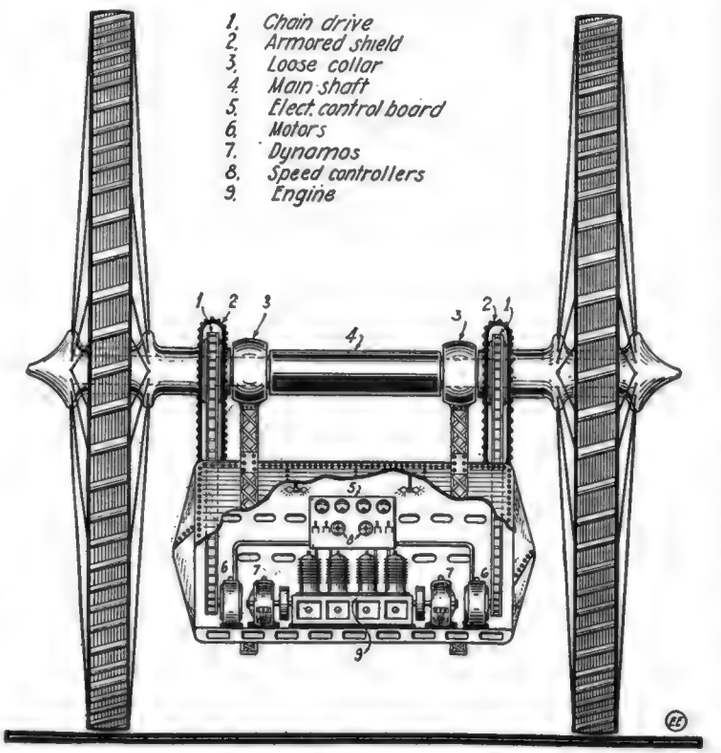
Recently we have heard much about the British "Tanks" which are a form of Trench Tractor themselves, but on account of their foolish disregard of war conditions as they actually exist, these "Tanks" at once proved a total failure. The writer is confident that the "Tanks" will not appear again in their original make-up.

A war machine of this class is at once foredoomed to failure for the following reasons. The "Tanks"—which are mere re-constructed agricultural tractors, carrying armor for protection—cannot advance at a faster pace than 4-6 miles per hour. On account of this ridiculously low speed the enemy finds but little trouble to plant shells upon it. Then again the "Caterpillar" tractor arrangement is a delicate piece of machinery—even a comparatively weak shot into a caterpillar will almost certainly disable the entire machine.

It is with these and other reasons in mind, that the author suggests in this article, a machine which may prove useful in future, to keep armies from entrenching. He has pointed out before that once an army entrenches itself, the usefulness of that army has ceased to exist for its country, except as a defensive measure. No war will ever be won or lost with the opposing armies *dug in,* in trenches. Both are deadlocked, as witness the contending armies in northern France to-day, now entrenched for over two years.

If we can invent a practical machine which will make trenches uninhabitable, wars will not last as long as the present one and consequently much bloodshed will be saved. Furthermore, and of far greater importance, is the fact that once governments come to realize that armies cannot be successfully entrenched, even for a defensive measure, they will be much more reluctant in declaring war upon each other.

Contrary to public opinion, the more terrible war machines can be constructed, the less the likelihood of the *next* war. Each government will be afraid of the other, for with a war fought by machines against machines, the outcome can never be foreseen accurately. In other words, the agressor stands as good a chance of losing as the defender.



View of the "Trench Destroyer," Showing the Electrical and Mechanical Features of the Propelling Mechanism. The Machine Is Steered by Running One Motor Faster Than the Other. Its Speed Varies from 10 to 20 Miles Per Hour and Its Armament Comprises 10 or More Rapid-Fire Guns.

As stated above the function of the Trench Tractor was to approach the trench at right angles, *riding* over it, thus making a gap for the infantry to pour thru. This maneuver, however, does not win a trench from the enemy.

The function of the writer's new "Trench Destroyer" is entirely different. It sets out to effectively drive the enemy from the best defended trench—in fact making intrenching impossible.

The Trench Destroyer is not a huge monster but a machine of rather modest proportions. Our front cover illustrates it better than a long, extended description could. There are two broad steel-rimmed tractor wheels, about 30 to 40 feet high and some 2 to 3 feet wide. The outside distance from wheel to wheel is not more than thirty feet. A shaft connects the two tractor wheels, which are operated individually by chain drive from two independent electric motors. A heavily armored car, housing 10 to 12 men, and the necessary artillery and propelling machinery hangs from the connecting shaft. The armored car measures about 16 feet long by 11 feet high, and hangs some 6 feet above the ground.

It will be noted that the wheels, as well as the car and all vulnerable parts of the machine, are so constructed as to be practically shell proof, except for shells of extra large caliber. The wheels are of the open lattice-work type, constructed similar to the American battleship fighting masts. The largest shell will thus pass thru both the wheels with ease and granting that a few spokes are damaged, the machine will not be disabled thereby. As the Trench Destroyer moves at the rate of from ten to twenty miles an hour, it should be rather difficult for heavy artillery to place shells in it accurately. If the pilot of the Trench Destroyer knows his business and runs the machine constantly at varying speeds, it will be almost impossible for the enemy to damage it by shell fire.

At any rate there is nothing delicate on the outside of the car, except the chain drive and this is encased in exceptionally heavy armor. Both extreme ends of the shafts are cone-shaped, to deflect shells. The same is true for the ends of the car body facing the enemy. It is shaped in the form of a pyramid and is thus certain to deflect small shells.

The battle action of the Trench Destroyer would be as follows:—First let it be understood thoroly that a single machine is of but small value; from six to twelve and more are needed if success is desired.

The first Destroyer approaches the trench at right angles. At the edge of the trench (or parapet) it slows down to almost nothing, only one wheel being run slowly. This has the effect of turning the machine around, and parallel to the trench. One wheel—remember it measures thirty feet high—now rides easily over the trench and in a few seconds, the Destroyer is astride over the trench. Power is then applied to both wheels and the machinery gathering speed rides over the trench, one wheel on each side of it. Parapets, wire entanglements, lateral connecting trenches, et cetera, will not impede the progress of the Destroyer. The wheels are so large and heavy, that small obstacles of this sort count for little more than an empty grocery box to a five-foot cart wheel—it simply passes over the obstruction.

In the mean time the ten machine guns —five in front and five in back of the car —have not been idle. They fire away into the trench below, raising terrible havoc as the machine rolls on. If there is much fight left, the next machine continues the work and by the time the last machine has

(Continued on page 765)

AMONG the hundreds of new devices and appliances publisht monthly in The Electrical Experimenter, there are several, as a rule, which interest you. Full information on these subjects, as well as the name of the manufacturer, will be gladly furnisht to you, free of charge, by addressing our Technical Information Bureau.

Electric Power From Ocean Waves

By H. WINFIELD SECOR

HAVE you ever been down by the seashore, watching the mighty waves of the ocean rolling in shoreward with their inexhaustible energy, and stopt to realize that if we could effectively utilize this tremendous amount of natural energy constantly going to waste, that we could light every office building, factory and dwelling not only in the United States, but also supply sufficient electrical energy for all of the light and power required in all parts of the world with plenty to spare?

In the past ten years and before that time, there have been numerous inventors who have devised many ingenious and curious machines and auxiliary apparatus whereby to effectually transform this mighty power into a more docile and easily controlled form of energy—such as electricity, which can be easily transmitted hundreds of miles overland thru sinewy copper wires to the point where it is most required. Many patents have been taken out on some remarkable *wave motors*, as they are generally termed, but so far none of them have proved sufficiently practical to warrant their adoption, for several reasons. These include the rise and fall of the tide and the constantly changing form and amplitude of the incoming ocean waves, etc.

The ocean, or rather the oceans of the world, and especially along the sea coast, seem to present wonderful opportunities for the production of electrical energy at practically no cost except the initial one for the installation of the necessary electrical and mechanical machinery.

The illustration which we have the pleasure of presenting herewith shows one of the latest wave motor schemes, devised by Mr. J. Verner. Mr. Verner has several good ideas for the general application of his wave motor, broadly speaking, and a few of the more practical ones are mentioned herein. Not only is this wave motor power plant intended to be efficacious when utilized to develop a few horsepower for such purposes as the illumination of lighthouses along the coast, but he also mentions that with a number of these scattered along a stretch of coast, they can be properly arranged to pass their electrical energy thru submarine electrical cables to shore, where the combined electrical output of a number of these wave motor plants can be arranged with a storage battery, etc., so that a very large amount of power could thus be realized. On the other hand, this design of wave motor plant appears to have a number of good features which might be employed for isolated lighthouses, which would eliminate daily and constant manual attention by anyone.

For instance, suppose that the plant shown in the illustration was designed on a small scale, simply to develop five to ten horse-power or even considerably less than this, and that by means of a suitable storage battery and automatic switch-board, the energy developed by the dynamo could be accumulated during the day. As evening approaches the battery current can be switched on to the powerful lamp on the roof of the structure by means of radio control waves sent out by a suitable wireless station on shore. Wireless antennae could be arranged on the roof of the wave motor tower as shown and at daybreak a second wireless impulse intercepted by the antenna would cause the electrical apparatus to open the lamp circuits, and so on.

There are a number of refinements, both electrical and mechanical, which are already in use in many applications of electrical and mechanical engineering, which could be very easily adopted to make such a power plant successful.

For instance, the speed of the dynamo will (ordinarily) fluctuate widely owing to the spasmodic action of the ocean waves as we all know. Mechanical speed governing devices could be arranged and are available, which would keep the dynamo driving shaft rotating at fairly constant speed; also the dynamo could be very well arranged with a fly-wheel pulley in place of the ordinary light weight pulley, which would tend to cause the dynamo to rotate at more constant speed. Also, there are electrical voltage regulators which act on the various windings of a generator and electrical regulators which could be placed in the storage battery charging circuits, so that the dynamo would be kept pumping electrical energy into the battery whenever the speed was above a certain minimum value. Automatic charging cut-outs are feasible for the purpose of opening the battery charging circuit when the battery has received a sufficient amount of energy.

Regarding the mechanical construction of the gear sectors and the main power shaft carrying the small gear pinions which mesh with the toothed sectors on the steel float arms as shown, there would of course ordinarily be created a to-and-fro motion of the main shaft as the floats rise and fall. To overcome this the float arms are only actively employed in the production of power with which to drive the dynamo during their upward travel, *i.e., when the waves force the floats upwards;* when they descend they cannot transmit mechanical energy to the main shaft, as the pinions

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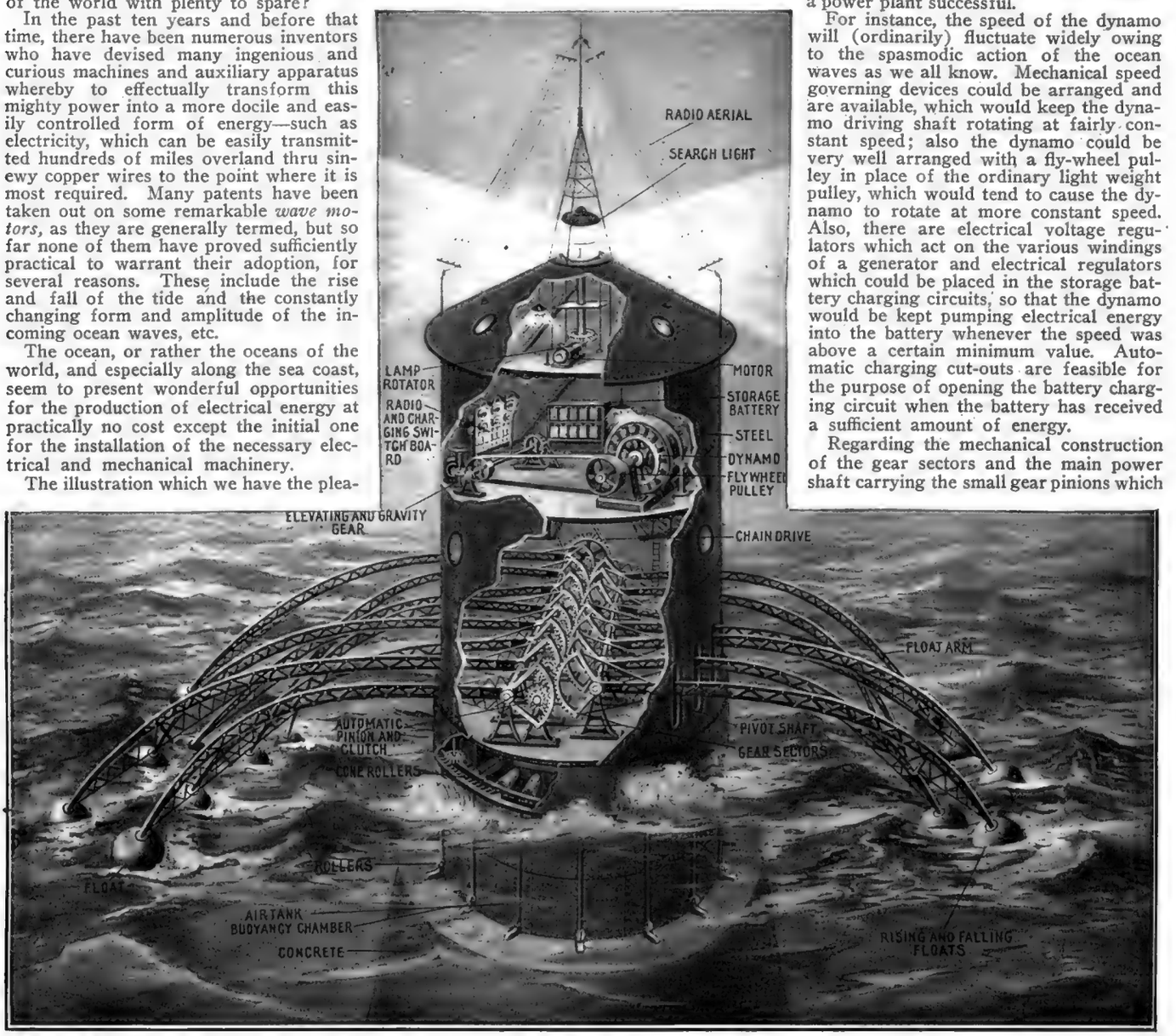
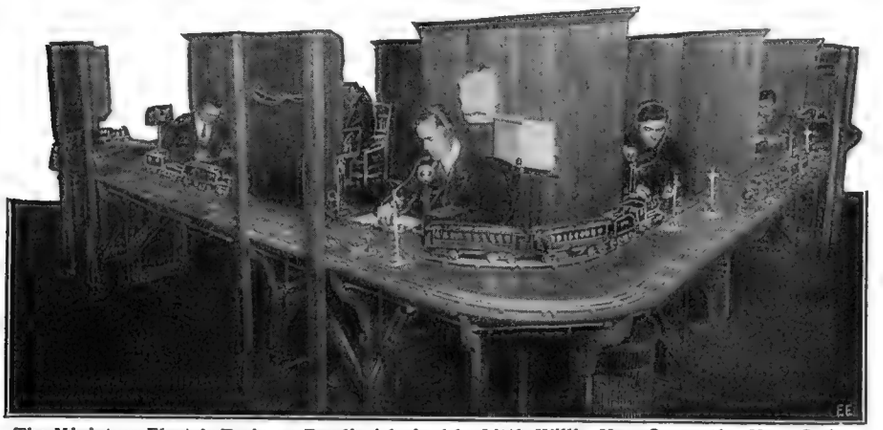


A Recent Invention for Utilizing the Vast Power of the Ocean Waves is Here Illustrated. The Rising and Falling Float Arms Act on a Common Power Shaft to Drive a Dynamo, which in Turn Charges a Storage Battery. A Radio Controlled Light-House is Shown Above, Fitted With Such a Wave-Power Electric Plant.

MINIATURE ELECTRIC RAILWAY TEACHES FUTURE RAILROADERS.

Of the 170 ranking officers of the vast Pennsylvania railroad system, 163, including President Rea, started at the bottom of the ladder and progrest thru a long course of preparation for their increasing burdens of responsibility. It used to be that an ambitious man had a hard time of it, in his efforts to learn the various technical details of his vocation, especially railroading. The Pennsylvania system has, however, always maintained an apprentice system at its Altoona (Pa.) shops. As the evolution of the railroad progrest, however, and the requirements became more exacting, it was realized that something more than mere mechanical training was needed.



The Miniature Electric Train, so Fondly Admired by Little Willie, Here Serves the More Serious Purpose of Teaching Train Dispatching to Future Railroad Men.

In consequence, one of the steps taken to meet the changing conditions was to organize an experimental apprentice school at the Altoona shops in February, 1910, in cooperation with the Pennsylvania State College. The regular course was established in the following fall.

When the embryo railroad men have learned how to handle a telegraph key to a fair extent, they are advanced to a room containing a model electric railroad in miniature, but complete in every detail, with block-signals, sidings, cross-overs, and interlocking devices and trains that really run pursuant to orders given by the manager, who plays he is a despatcher, while the students are the operators at stations on the line or conductors on the trains. The trains are actually moved over the lines exactly as the life-sized trains move over a modern railroad system.

In addition, the train and message-wires of the Bedford Division are extended to the school to afford the students an opportunity of listening to the actual handling of trains over the division. The students also receive instruction in agent's work, including the system of accounts.

At stated periods, representatives of the traffic department deliver lectures on courtesy and the proper manner of dealing with the public.

When the students can pass the final examination with a percentage of 95, which is usually in six to eight months, they graduate into jobs with the assurance that if they attend to their business, they can count on steady employment and be in line for promotion. After six months' satisfactory service the company returns all tuition fees.

ELECTRICITY THIRTY-SEVEN YEARS AGO.

Some amusing incidents of an electrical nature which happened thirty-seven years ago are recalled by the *Electrician*, the issue of that journal for November 1, 1879, having contained articles on them. We read:

"The Pullman Dining Car.—To-day the Great Northern Railway commence running with the Leeds express a Pullman car fitted up as a dining-room. Dinners, similar to those obtained in an ordinary restaurant, can be obtained in this carriage any time during the journey. We noticed during the recent trial trip to Petersborough that the car was fitted with *electric bell apparatus*

"Telegraphing Without Wires. — Our American contemporary, the *Journal of the Telegraph*, states that Professor Loomis continues his experiments in the mountains of West Virginia to demonstrate the theory that at certain elevations there is a natural electric current, by taking advantage of which telegraph signals may be sent *without the use of wires*. It is said that he has telegraphed a distance of eleven miles by means of kites flown with copper wires. When the kites reached the same altitude, or got into the same current, communication by means of an instrument similar to that of Morse was easy, but ceased as soon as one of the kites was lowered. He has built towers on two hills about twenty miles apart, and from the tops of them has run up steel rods into the region of the electric current."

GOVERNMENT CONTROL OF WIRELESS URGED.

Authority to establish a government monopoly of radio communication between ship and shore stations thru the purchase of all private radio stations in the United States is to be sought from Congress.

"The necessity for strong Government control of radio communications becomes more necessary as ship and shore stations increase in number," Director Todd says in his annual report. "Interference and consequent inefficient communication will continue until such control is obtained."

POLICING NEW YORK BY WIRELESS.

Policing a great metropolitan city by wireless is the latest idea of the New York Police Department. It is one more rung added to the ladder of preparedness.

The object of this plan of equipping several motor trucks with wireless apparatus is that in case of accident, when telephone, telegraph and other means of communication fail there will be one other resource available for transmitting intelligence.

The accompanying photograph shows one of the motor trucks in use by the New York City Police Department, equipt with a powerful and complete radio transmitting and receiving outfit.

The antenna is supported by a substantially built mast, the antenna proper consisting of six strands, properly insulated and stretched from the masts to the truck.

The transmitting outfit consists of a 10-inch spark coil excited by storage batteries, the charging current of which is obtained from a generator connected to the automobile and automatically controlled by suitable switches, all of which are mounted on a large switchboard visible in the front part of the automobile.

The oscillating circuit of the outfit consists of an inductively coupled tuner or transformer, the primary of which is connected with a spark gap and condenser.

A Morse key is employed in the primary spark coil circuit, which is used to interrupt the battery current so as to produce the proper code signals.

The receiving outfit consists of the usual inductively coupled set comprising a loose coupler, variable condenser, detector and telephones.

The New York City Police Department Believes in Being Thoroly Up-to-date. It Has Several of These "Radio" Auto Trucks for Emergency Use when Other Forms of Communication Fail.

When Electricity Puts Out The Fire

The many advantages of electrical service in up to date fire fighting are being slowly but surely recognized. New York City, the greatest metropolis in America with its 4,000,000 souls, is dependent largely for fire protection on an elaborate high-pressure water system operated by powerful electric pumping stations. If their electric current supply is interrupted during a fire there is a penalty of $400.00 per minute. Electrically propelled fire engines and ladder trucks recently proved superior to other types when tested over identical routes.

ELECTRICITY as a fire-fighting agency does not appeal to the lay mind at first, possibly for the reason that when we see a short circuit there is invariably an unprecedented pyrotechnical display that startles the most phlegmatic man. Once he sees a good, lively short-circuit, then he invariably has all due respect for the mysterious "juice." But to those who understand the vagaries and laws governing the electric current there is a world of opportunities open in which to make it perform not only useful, but extremely valuable work. For instance, the electrical engineer says—instead of allowing this wonderful form of energy to create fire, why not put it to work and make it put out fire. No sooner said than done—so flexible—so docile does this unseen energy become under the guidance of master minds. Electricity is being more widely recognized each day for just such emergency and all-important duties as this. The present discussion brings out some little known facts on this latest rôle of electricity—one that we all think of at some time in our lives—perhaps not until the flames threaten to envelop our home, but when we want fire-fighting service—men, equipment, and last but not least—water! we want it quick.

To interrupt its flow for even a minute might prove disastrous. To provide against dangerous conflagrations New York City began the installation of a high pressure fire (water) system nearly ten years ago, since when many remarkable improvements have been made and the service extended northward to Twenty-third Street and all the way across Manhattan Island below Houston Street. The work of this great system has proven beyond a doubt that it is the only effective method of fighting fire in big cities and that all others must eventually give place to it. Manhattan below Twenty-third Street is thickly dotted with high pressure hydrants. At the start there were but a few hundred hydrants in certain feared districts known as danger zones. Now there are 2,372 hydrants, 108 miles of high pressure mains, and 4,085 valves. The city has now authorized the extension of the service as far north as Thirty-fourth Street from the North River to Madison Avenue.

The most recent improvement in the high pressure system is the introduction of two *electrically operated valves*, which, when closed, separate the district supplied by the Gansevoort Street pumping station from that supplied by the Oliver Street pumping station, or which, if opened, make it possible for either pumping station to supply the entire system. The enormous value of these valves would be demonstrated in case of a break in one of the water mains. Should such an emergency arise, the engineer in either station, by throwing a switch, can instantly separate the two districts until the break is repaired and in the meantime the service in the unaffected district would be undisturbed. On the other hand, if either of the pumping stations should be crippled the valves can be opened and the whole system supplied by the working station.

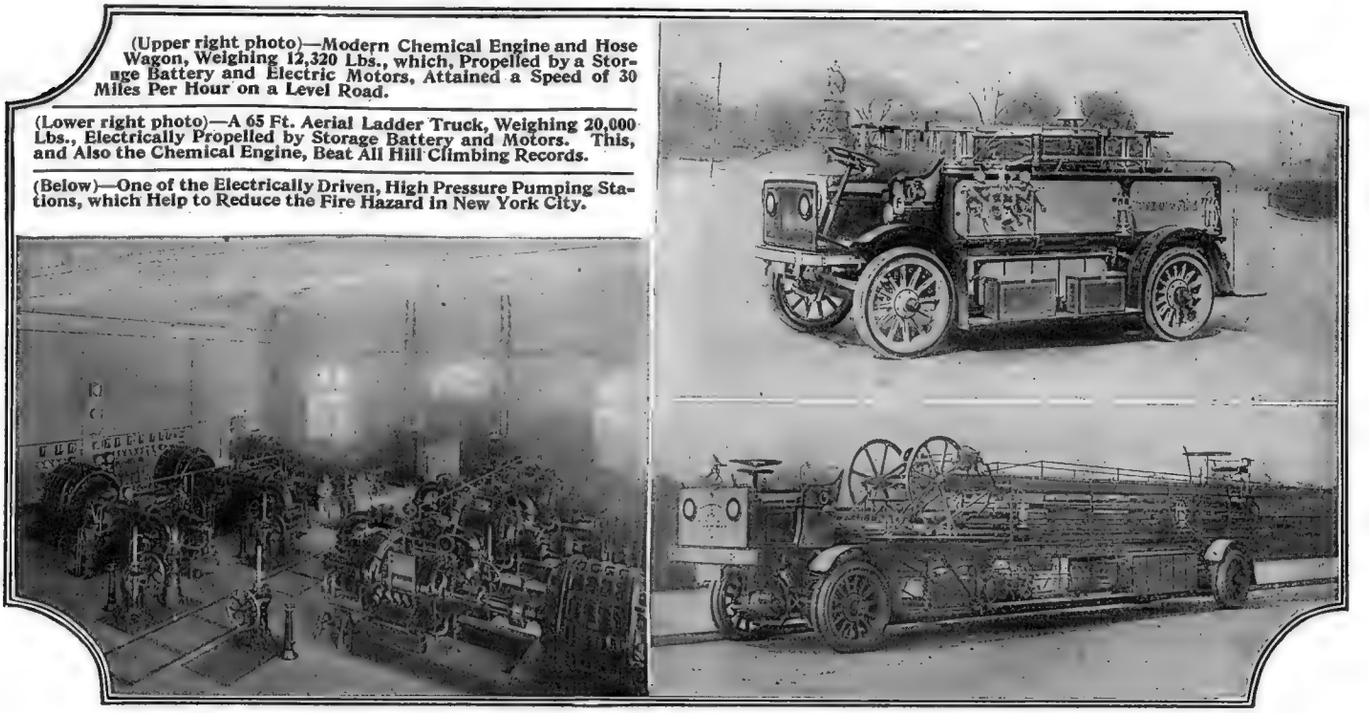
One of the new valves is located at Hudson and North Moore Streets and the other in the Bowery just a little south of Houston Street. Each one is operated by a five-horsepower motor located in the vault under the street, and in addition to the electrical control switchboards in the stations there is a control board in both vaults where the valves are located, so they may be operated from the pumping stations or in a rare case of emergency, from the vaults.

Another motor-operated valve is also being installed at Stone and Whitehall Streets, as an accessory to the duplex system. This will make the third valve in the duplex system, others being located in Houston Street east of the Bowery, and New Chambers Street and New Bowery. Although beneath a street is scarcely a fit place to keep an electric motor and its controlling mechanism, these motors have continued to work in perfect condition since they were installed. They are tested, together with the valves, every day from the Oliver Street station.

The *duplex*, or *White* and *Green* system as it is also called, because of the color of the hydrants, is, as the name denotes, a double set of high pressure water mains and hydrants in the same territory. This seems the last word in emergency, for, in case of a break in either set, the pressure can be instantly transferred to the other and the firemen change their hose from green to white or white to green hydrants. Roughly speaking the duplex system takes in the entire east side of the island from Houston Street to the Battery and from the Bowery, Park Row and Nassau Street to the East River. In this territory are packed thousands of tenements, old-time buildings of every description, storehouses and wharves, and it is well that every precaution should be taken against the spread of fire.

The equipment of the two high pressure pumping stations is the same. The interior of the Gansevoort Street station is here shown. (In each station are six motor-driven Allis-Chalmers centrifugal pumps, designed to pump 3,000 gallons of *sea* water or 4,200 gallons of *fresh* water a minute, at a pressure of *300 pounds per square inch!* Thus the combined capacity of the stations is 50,400 gallons of fresh

(*Continued on page 778*)



(Upper right photo)—Modern Chemical Engine and Hose Wagon, Weighing 12,320 Lbs., which, Propelled by a Storage Battery and Electric Motors, Attained a Speed of 30 Miles Per Hour on a Level Road.

(Lower right photo)—A 65 Ft. Aerial Ladder Truck, Weighing 20,000 Lbs., Electrically Propelled by Storage Battery and Motors. This, and Also the Chemical Engine, Beat All Hill Climbing Records.

(Below)—One of the Electrically Driven, High Pressure Pumping Stations, which Help to Reduce the Fire Hazard in New York City.

"INVENTION."

In the courtyard of Charles M. Schwab's palatious mansion in New York City one finds this magnificent statue—typifying in noble lines the physical aspect of "Invention." The figure represents a man in deep thought; in his hand he holds a plan or drawing, while a piece of machinery rests at his feet. It is rare that we find a sculptor who can carve a figure out of cold marble that shall at once be so attractive and represent so great a human endeavor as the name it bears implies. The figure wears a laurel wreath—a symbol of some great idea carried to completion and awarded a prize, yet, as you gaze upon the mood here exprest so faithfully, it is not difficult to interpret or feel that the inventor is not done thinking, thinking, thinking. And so it is with the world we live in—Invention has made possible all of the really wonderful luxuries that we enjoy to-day. The telephone and telegraph, wireless, the subway, the railway and automobile, airships—all were once a mere, insignificant idea in an inventor's mind. But the idea would not rest; the man who possest it was ever obscessed with it—no matter whether it related to a new form of clothes-wringer or an electric typewriter—and eventually, maybe slowly, but surely, the invention—once a faint idea—is born. The present statue is a rare masterpiece without a shade of doubt in that it expresses, instantly, the superior motives and many moods which personify Invention—in all its many aspects—work, study, worry, fame and emolument.

Photo by Brown Bros.

"Invention" — A Masterpiece in Marble, Owned by Charles M. Schwab of New York. The More You Gaze At It, the More Apparent the Art of the Sculptor

On the death of Mr. and Mrs. Schwab, the City of New York will be presented with the statue.

HOW ENGLISH "CENTRALS" FELT IN A "ZEP" RAID.

By Nellie Ward (Assistant Supervisor).

When the emergency staff of a certain southwestern exchange were advised to report for duty on the evening of September 23, 1916, they little anticipated the ordeal they would undergo within the next few hours.

It was shortly after 10.30 p.m. that various emergency messages were received and these were circulated to the specified subscribers in a manner which spoke volumes for the way in which the telephonists have been trained to deal with these calls.

About 12.15 a.m. the distant booming of the anti-aircraft guns announced the fact that the Zeppelins were approaching, but we were unable to pay much heed to them as the traffic demanded all our attention. At 12.30 a.m. the firing grew very heavy and we then knew that the "Zeps" were in the vicinity, and resolved to maintain control over our feelings and perform our duty bravely.

A few minutes later there was a terrible crash, followed by a succession of deafening explosions which literally shook the building. The last bomb which was dropt was responsible for a rush of work.

Needless to say we were only too glad to have this additional labor thrust upon us, as it helped considerably to divert our thoughts from our danger, several of the operators being kept in ignorance of the fact that the throb of engines could be distinctly heard overhead. The noise, however, suddenly ceased and then we set to work to deal with the fire, police and ambulance calls of which we received a large number.

One cannot help admiring the courage of the staff, who never for one moment thot of themselves, but were only too anxious to help those unfortunate people who were suffering from the effects of the raid. Several of the subscribers thanked the telephonists for the prompt and efficient manner in which their calls had been dealt with and we all felt more than repaid by these expressions of gratitude.

As soon as the final emergency message had been circulated and advice was received to release the staff, as many as could conveniently be spared were sent into the rest room, but needless to say, they were too excited to sleep, but sat up talking until it was light, when, having partaken of some breakfast, they returned to the exchange where they remained until their services could be dispensed with, which was about 10:30 a.m.

However, I am pleased to add that we are fortunately none the worse for our thrilling experiences, but very proud of the fact that we have been able to do a little to help our country in her time of need, but we feel sure that we only did what any member of the "London Telephone Service" in the same circumstances would have done.—*The Telegraph and Telephone Journal, London.*

MEXICAN GIRL WINS RADIO DIPLOMA.

AT the age when many American girls are just leaving home for boarding school, Maria Dolores Estrada was watching men kill each other in frenzy of battle. She has known what it is to languish starving and without water in one of those horrible Mexican prisons; and she has hidden, terror-stricken and alone, while the terrible Villa and his more terrible bandit followers have searched from house to house to find her.

For two years before she came to Washington she served on the official staff of General Venustiano Carranza, first chief of the de facto government of Mexico and leader of the rebellion against Huerta.

When Miss Estrada arrived here last January she could not speak a word of English. Her father having died when she was only twelve years of age, she had learned telegraphy, and at fifteen was a government telegrapher in Zacatecas when Madero unfurled the banner of rebellion against Diaz in 1910.

Eventually she came to the attention of General Carranza, who employed her at once as his private telegrapher on his official staff. Last January the first chief decided that she should come to the United States to learn English.

But Maria wanted more than a knowledge of English. She heard that by using her spare time she could add to her knowledge of telegraphy that of wireless.

How she applied herself is mutely testified to by the certificate which she proudly holds as a first-grade wireless operator. And because there was more time that could be spent to advantage in this wonderful country of opportunity, Maria also learned stenography.—*Photo courtesy National Radio School.*

Miss Maria Dolores Estrada, Mexican Girl Who Has Been Granted a First Grade Commercial Wireless License by the United States Department of Commerce.

AN ELECTRIC WASHING MACHINE OF UNIQUE DESIGN.

Every mother and every father knows that practically from the date of baby's birth it is wash, wash, wash every day. No one will dispute that it is a tiresome, ever recurring task. And yet how easy it is with an electric washer. Place the soiled clothes in washer, fill with hot water, add a little soap, turn the electric switch, and while making beds or cleaning the home, the clothes are being washed—twelve minutes to a washer full—no fuss, worry or rubbing, everything washed clean and white.

But it washes other things, too. If there are only two and the baby in the family, it will probably do all the washing, fine waists, underwear, lingerie, sheets and pillow cases, table linen, etc., holding as much as three sheets or seven shirts in one washer full for the *Baby* size machine. If apartment or bathroom is above the ground floor there is no counting the many, many steps saved. A detachable hand wringer, clamped on back, is furnished with each large size washer, which has a capacity of nine sheets.

When used in the bathroom, there is no lifting, hot water being run into washer with a bathroom hose and dirty water draining into hopper bowl.

In this unique washer a powerful circulation of hot suds is forced thru the clothes, which remain always entirely under water in a wire cage cylinder free to revolve, instead of stirring or plunging and lifting the clothes in and out of quiet water. An electric motor at the bottom of the machine revolves a propeller blade at high speed; this forces the soap and water, up thru the rotating wire cage drum containing the clothes.

A Novel Electric Clothes Washer With a Capacity of 9 Sheets. The Revolving Cylinder is Shown in Upper Position for Convenience in Removing Clothes. A Motor-Driven Propeller Forces a Jet of Soapy Water Up Thru the Revoluble Cage Containing the Soiled Clothes.

THE MECHANISM OF LIGHT PRODUCTION IN ANIMALS.

It has long been known that the dried powdered luminous organs of the fire-fly will glow if moistened with water containing oxygen. No light is given off if oxygen is absent. In a previous issue of *Science*, writes Mr. E. Newton Harvey in that publication, I pointed out that if we allow this dried powder to stand for an hour in contact with water carefully freed of its dissolved oxygen and then admit oxygen, no phosphorescence is to be observed. It is quite obvious that the photogenic substance has been changed in some way even though no oxidation has taken place. The substance, therefore, which in presence of oxygen is oxidized with the production of light, in absence of oxygen is also decomposed but without light production. We have an analogous instance in the compound lophin (triphenylglyoxaline) investigated by Radziszewski. If hydrolyzed in presence of oxygen by alcoholic potassium hydrate, light is produced and benzoic acid and ammonia formed. In absence of oxygen, no light is produced and benzaldehyde is formed instead of benzoic acid. The alkali acts as a catalyzer.

In the fire-fly it is natural to suppose that an organic catalyzer, an enzyme, is concerned in light production and it is the purpose of this paper to point out the fact that the existence of such an enzyme has been definitely proved and to add certain new facts to our knowledge of bioluminescence. The credit of this discovery belongs entirely to Professor Raphael Dubois, of the University of Lyons. As early as 1884 Dubois made the crucial experiments in which he showed that two substances are present in the luminous organs of *Pyrophorus noctilucus*, the West Indian cucullo, a thermostabile substance, luciferin, which oxidizes with light production and a thermolabile enzyme luciferase. In 1887 Dubois showed that the same was true for the luminous mollusc, *Pholas dactylus*. If the luminous slime from glands on the siphon and mantle of this mollusc are collected in sea water in two test tubes the solutions will phosphoresce for some time. Boil the solution in one tube and the light disappears instantly; allow the solution in the other tube to stand until the light disappears spontaneously. Then if both tubes, now dark, be mixed, the light reappears. The boiled tube contained luciferin but no luciferase while the other tube contained luciferase but all the luciferin had been oxidized by standing. On mixing, the two substances were again brought into contact and light resulted. In later papers Dubois has studied especially the properties of the *Pholas* luciferin and luciferase and the results are published in many papers in the *C. R. Acad. Sc. Paris* and the *C. R. Soc. Biol.* He says that luciferin is an albumin having acid properties and an active reducing power. It oxidizes readily with luciferase, potassium permanganate, barium peroxid and lead peroxid, giving off light and forming amino-acids and minute crystals giving the test for xanthin.

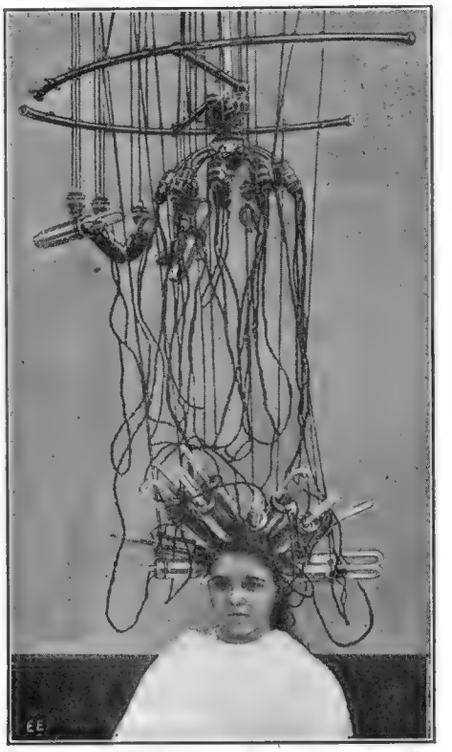
Luciferase, on the other hand, has all the properties of an enzyme, an oxidizing enzyme acting in the prescence of iron salts, which will oxidize luciferin and also tannin, guaiac, a-napthol, etc. It resembles the oxydones of Batelli and Stern which are destroyed by ether, chloroform and acetone. It passes with difficulty thru porcelain and is non-diolyzing. At 60° C. it is destroyed by heat, as also by digestion with trypsin.

Luciferase of one form will act with luciferin of another, and *vice versa*. This is true for the two genera of eastern fire-flies (*Photinus* and *Photuris*) and for the West Indian *Pyrophorus* (*Elsteridæ*) and *Photuris* or *Photinus* (*Lampyridæ*). Fire-fly luciferin will give no light with extracts of non-luminous parts of the fire-fly or

(*Continued on page 768*)

ELECTRIC HAIR WAVING AND CURLING THE BEST.

It is often the case that woman's main beauty lies in her coiffure, and consequently when Nature has not bestowed upon her ladyship, beautiful wavy hair, she must resort to other (shall we say artificial) means to obtain the desired result. In an effort to be of service to the ladies, one Mr. C. Nestle has devised and perfected an electric curling or waving machine which will produce permanent rippling tresses and at the same time improve their growth.



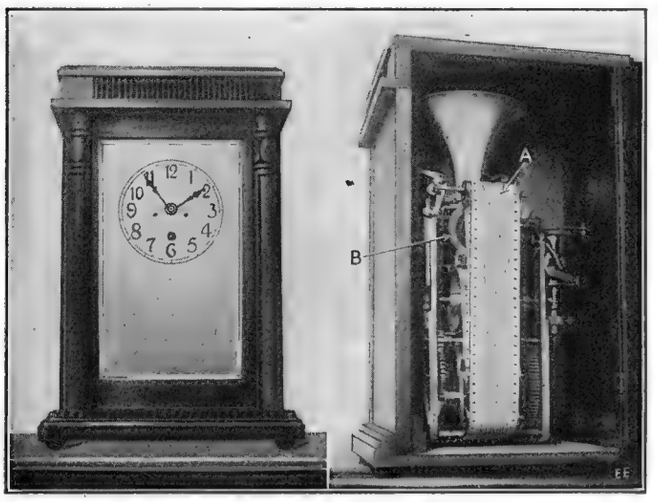
The Contented Looking Young Lady in the Picture is Receiving the New Electric Heater Treatment for Putting a Permanent Wave in the Hair. It Looks Dangerous But is Harmless and Painless.

The device in detail consists of a small metal tube in which an electric resistance (heating) coil is placed. This is used for heating a helical form in which the hair is placed when curling is desired. In actual work several such units are employed. Before the heaters are placed over the head, the hair is first treated with a special paste, which softens the hair, then the tube containing the heater and also a suction device for producing a partial vacuum are placed in the proper position and the current turned on. The current is permitted to flow for a short time and then the equipment is removed.

The accompanying photograph shows a "patient" being treated wit' the Nestle apparatus. The heaters are finely balanced so that their weight is completely neutralized. They are not fixt either, but can move in any direction automatically as necessitated by any movement of the head. The treatment occasions no inconvenience or pain to those taking it and by having available a large number of the electrical wavers as here shown, the whole operation need consume but a short time.

An Electric Clock that "Speaks" the Time

HOW would you like to have a clock that calls out the time every fifteen minutes? Clocks of this character have been experimented on for many years, but with no distinct success in most cases. Lately, however, a well-known civil engineer, Mr. H. Hartman, inventor of the *Electric Submarine Camera*, described in the December issue, has devised and constructed a successful electric clock which will actually "speak" the time at intervals of fifteen minutes.



Behold! The Electric Clock That "Speaks" the Time. "Two-O'-Clock"—Says the Speech Reproducing Mechanism, which Resembles a Phonograph. And What Can't This Clock Call One at 6 A.M. in the Morn'. Zowie!

The two views herewith show the instrument clearly. The view to the left is that of the face of the clock, and the one at the right shows the complete mechanism normally concealed by a hinged rear door.

The motive power is derived from an electric motor stationed within the clock cabinet. The clock movements are standard and possess no unusual features with the exception of an automatic lever and cam placed on the minute wheel shaft of the clock so as to actuate the lever at intervals of say every fifteen minutes. This attachment acts upon another lever attached to a drum which carries a photographic film "A" as seen. When the second lever is actuated by the first, it causes the electric motor to operate, which starts the film moving. In doing so, the stylus of the phonographic reproducer "B" is acted upon and thus the time is vocally announced or spoken. Of course the phonographic film is so made as to announce the time according to the manner in which the machine is adjusted. The film is made in a peculiar manner and a few words regarding this may not be amiss.

The first process is to record the *voice impression* of the time, as—*half-past two, a quarter to three,* etc., until the complete twelve hours have been covered. These impressions are made upon a soft, wax drum, the width of which is the same as that of the width of the film. After the impression is made, the complete form is covered with pulverized grafite and is then put in a copper electro-plating bath.

A sufficiently heavy coat of copper is put on, and the wax is then removed by melting it. A thin copper ring then remains, which contains the *voice impressions.* It is then accurately placed on a steel drum and the film which is to be embossed with the impressions is rolled under the steel drum. The impressions are thus transferred to the film and it is ready to announce the time like a human.

The film is heated during this process as the tenacious properties of celluloid makes it impossible to emboss it properly when in a cold condition. Hundreds and even thousands of such films can be made with one of these prepared steel master-drums.

The phonographic reproducing head is fitted with a small horn which intensifies the sounds. These sounds are permitted to escape thru a large number of holes made in the side of the clock cabinet. The movement of the control mechanism can be adjusted so that it will call out the time at any interval desired. The clock is also fitted with a repeating device so as to repeat the time any number of times. This wonderful electric "speaking" clock should certainly appeal to those who find it difficult to arise when "getting up" time comes. The owner of such a clock may sleep to his heart's content and the faithful timepiece will "tell" him when to turn out. We even imagine that for some heavy sleepers it would be a capital idea to have a *special section* recorded on the film which could be made to function at 6 A.M. in the cold and chilly morn, and start up something like this: "6 A.M.—six o'clock—6 A.M.—six o'clock! Hey, IEY!! Get up. *Lookatatime!!* You'll be late again!!"

This latter film is especially desirable for husbands whose wives are away.

DOUBTFUL IF RADIUM CURES CANCER.

The $3,000,000 Crocker Cancer Research Laboratory of Columbia University, after many months spent in experimenting with radium on animals and human beings, reports that it has made no cures.

Radium in small doses, says Dr. Francis Carter Wood, the Director, has a distinctly stimulating effect on such cells as occur in cancer tumors, while large doses, just insufficient to kill the tumor, may reduce its rate of growth considerably.

"This explains," he adds, "many of the reports of physicians treating human tumors to the effect that a growth disappeared but returned after being quiescent for a considerable period. In some of these human cases the tumors have remained latent for one or two years, only to grow later and resist any further radiumization.

"These experiments are thus of practical importance because they show that in treating a tumor of any size, unless very large quantities of radium are used, the portions of the tumor at a considerable distance from the radium may be stimulated and grow more rapidly, even tho locally the tumor may diminish."

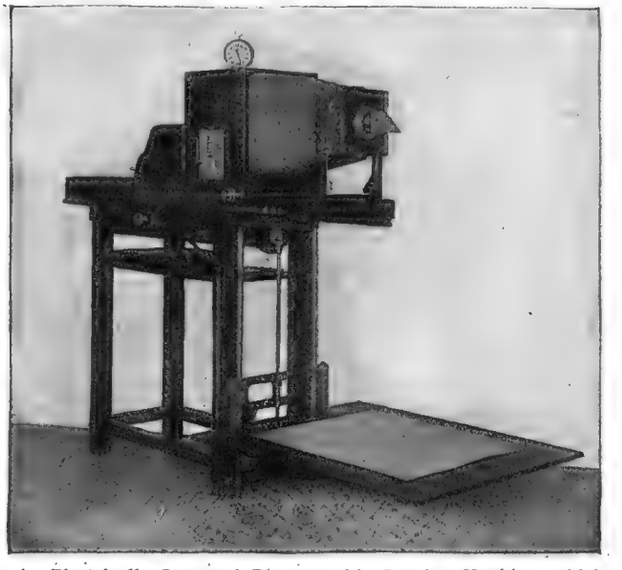
The Director recommends radium as a palliative to ease pain and prolong the life of the patient.

The Imperial Cancer Research Fund of London, fearing destruction of its laboratory by Zeppelin bombs, sent many of its cancerous mouse tumors to this country, and they were transplanted in Columbia's mice.

NEW ELECTRICALLY OPERATED PHOTOGRAPHIC COPYING MACHINE.

Office managers are always on the watch for anything in the realm of machinery that will—to paraphrase a well-known saying—make two results grow where but one grew before. One of the latest devices for making photographic copies direct upon paper without the need of a transparent machine is known as the Photostat, and it works, like the proverbial lightning, according to its sponsor's claims. It is an easily operated commercial device, designed for use in places where a large number of copies of drawings, plans, sketches, legal papers, and similar documents are wanted. It is practically a large camera equipt with a self-contained arrangement for developing and fixing.

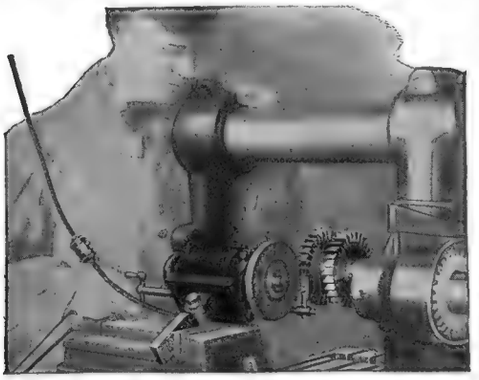
A roll of specially sensitized photo print paper is held in the machine and the subject to be copied is photographed, in a few seconds' exposure, directly upon the paper. The paper photograph is then wound directly into the developing both without being touched by hand, and is cut from the roll by the pull of a lever. In thirty seconds the print is developed and then drawn into the fixing bath, where it remains while subsequent copies are being taken in the same manner. When the desired number have thus been made, they are removed from the fixing bath to a tank of circulating water, which quickly washes the prints free from chemicals. The prints are then dried between blotters, or laid on cheesecloth stretches, or by passing them rapidly through a heated mangle. This completes the process and the prints are then ready for use. The operation is extremely simple, requiring but a few minutes to complete. The light can be supplied by two Cooper-Hewitt mercury vapor lamps adapted for operation on either direct or alternating current.



An Electrically Operated Photographic Copying Machine, which Produces Duplicates of Plans, Sketches, etc., on Paper at High Speed.

A PORTABLE MOTOR-GRINDER WITH A SPEED OF 30,000 R.P.M.

One of the latest electrical aids to the machinist is a portable motor-driven grinder, not a common emery wheel fitted to a motor shaft for rough work but a superfine device capable of being attached in a



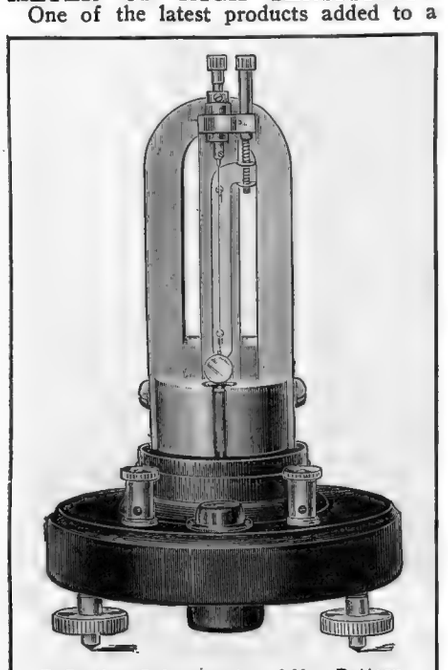
A Remarkable Motor-Grinder Capable of Driving a Grinding Wheel at 30,000 R. P. M. and which Can Be Attached Anywhere in a Few Minutes.

jiffy to a lathe or milling machine and facing down a piece of steel with an accuracy of one ten-thousandth of an inch.

The whole grinder weighs but 17 pounds and it can be connected with any lamp socket, the motor being of the universal A.C. and D.C. type. The motor spindle runs at 10,000 revolutions per minute (R.P.M.), while the internal grinding attachment or auxiliary shaft rotates at three times the motor speed or 30,000 R.P.M., sufficient for practically the finest of machine work. The whole machine is dynamically balanced and both the motor and high-speed auxiliary shaft are provided with ball bearings, resulting in a minimum of end play and vibration. It is claimed that this remarkable little machine will do any and all kinds of difficult external and internal grinding with an accuracy superior to the average grinding machine. Moreover this motor-grinder may be carried from job to job.

NEW ALL-AROUND GALVANOMETER OF HIGH SENSITIVITY

One of the latest products added to a well known line of scientific apparatus is the galvanometer here shown. It is reasonable in first cost and is of high sensitivity. Since this galvanometer is intended for general laboratory use, it is not furnished with extremely high sensitivties, but is, however, provided with removable suspensions so that replacements may be readily made.



Reflecting Galvanometer of New Pattern, which Possesses Several Meritorious Features.

The magnet is made of special steel with poles so shaped as to produce a radial field in order to reduce, as far as possible, the effect of foreign magnetic particles in the coil. The latter is wound of specially selected wire, as free as possible from magnetic impurities. The suspension is made of special rolled silver strip. The mirror, ½" in diameter, is furnished either plane or concaved, as desired.

The adjustment shown at the top of the magnet of the galvanometer carries a knurled head, by means of which the coil may be turned for zero adjustment. A second knurled head is provided as shown, by means of which the coil may be clampt to prevent damage to its suspensions when the instrument is being moved. The instrument is inclosed in a cylindrical metal case, with a large glass window in front. The galvanometer is mounted upon an insulating base supported upon three leveling screws.

A SMALL ULTRA-VIOLET RADIATION INSTRUMENT FOR THE LABORATORY.

The chemical power of ultra-violet radiation as evidenced in the reduction of silver nitrate, etc., has been known for many years, but its wonderful property of exciting fluorescence and phosphorescence in certain mineral and organic compounds is not so commonly understood and recognized. Roughly speaking, the ultra-violet spectrum may be said to extend about two octaves beyond the visible spectrum, say from 4,000 A.u. to 1,000 A.u. When the invisible radiation somewhere within these limits of wave length falls upon a substance that possesses the property of fluorescence, the waves are absorbed by some atomic mechanism which we do not yet understand very well, and they are reflected or emitted again as light waves of greater length, thus dropping for the most part within the limits of the visible spectrum so that the substance in question, altho excited by a beam of *invisible* light, glows with one of the colors of the visible spectrum.

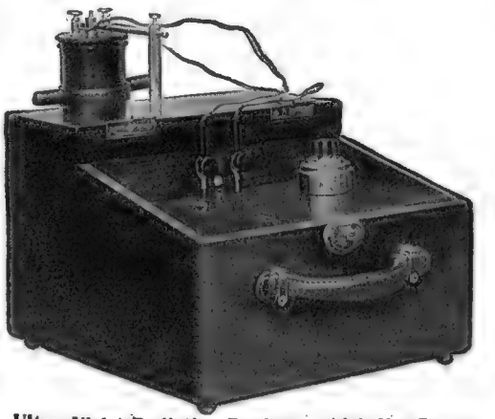
Different substances require different wave lengths to excite them to a maximum fluorescence, so it is, therefore, obviously desirable that the *ultra-violet radiation* used for producing fluorescence should include as much as possible of the invisible spectrum. In other words, if we could speak of it as visible light we might say that it should be polychromatic.

The high tension disruptive electric spark between iron terminals is very rich in ultra-violet radiation covering about 80 per cent of that part of the spectrum which is useful for producing fluorescent effects. An apparatus for producing such ultra-violet rays in abundance is illustrated herewith.

This outfit comprises a small transformer that steps up 60-cycle, 110-120-volt alternating current to about 4,000 volts; also a suitable condenser; an adjustable spark gap with removable iron terminals, the whole being protected in a chamber of insulating material and sundry fittings with connecting cords and plugs, etc.

All of the above parts are fitted into a neat mahogany box for convenient transportation, and it is only a few minutes' work to take out the spark gap, fit it in position and connect the apparatus to any suitable current outlet. As this outfit only uses about 250 to 300 watts it can be safely connected to any alternating current lighting circuit. The high tension condenser and iron gap are shunted across the secondary terminals of the transformer.

The iron electrodes are enclosed in a small cylindrical chamber of insulating material, open at one end only, and having

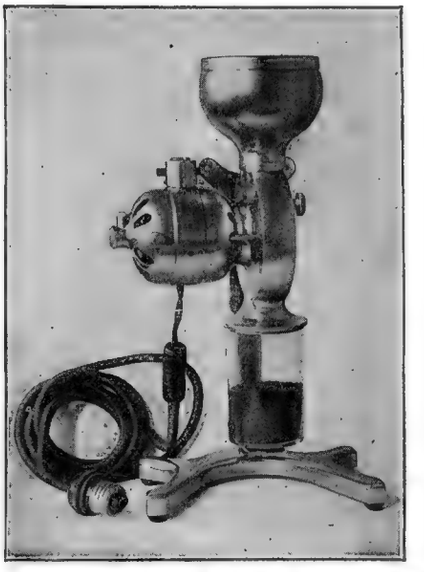


Ultra-Violet Radiation Producer which Has Proven Eminently Successful in Measuring the Wave Length of Certain Fluorescent Materials.

the insulated heads of adjusting screws projecting outside, by which the operator is able to regulate the frequency of the spark from 120 per second (with 60-cycle current) up to ten or twenty times that value.

SNAP THE SWITCH AND GRIND YOUR COFFEE.

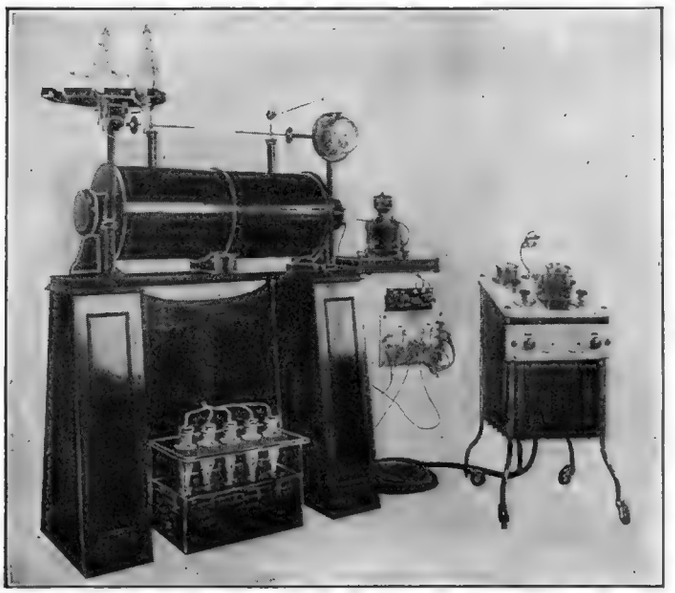
The particularly neat and efficient electric coffee grinder shown was exhibited at the recent Electrical Exposition held in New York City, and attracted considerable attention. It is arranged with a small, well-built electric motor operating off the lighting circuit, which is direct connected to a special grinder wheel. This rotates at high speed within a cylindrical metal housing. The bean coffee is placed in the hopper at the top after the motor has been started up and the ground coffee emerges at the bottom of the cutter housing into the glass cylinder as seen. The ground or cut coffee is readily removed as the catch glass snaps into or out of the machine in a jiffy.



A Newly Devised Electric Coffee Grinder which Will Appeal to Every Housewife. It Grinds to Any Fineness Desired.

A MAMMOTH 20-INCH SPARK X-RAY OUTFIT.

An extremely large, spark coil type, X-ray outfit of English design is shown in the accompanying illustration. It comprises a Cox model induction coil of the low ratio pattern, capable of giving a very heavy discharge across a 20-inch air gap, continuously.



Huge 20-Inch Spark X-ray Coil Outfit of English Design. It Is Equipt with a Multiple Electrode Electrolytic Interrupter as well as Mercury Interrupter for Handling Extra Heavy Primary Currents.

A variable inductance switch, mounted on the end of the coil, enables the selection of eighteen different degrees of inductance, rendering the coil equally efficient under varying conditions. It is particularly suitable for the most rapid radiographic work where high penetration is required, also deep therapy.

The improved Coolidge tube, backing up a spark of 15 inches, may be employed, and by this means a massive dose of homogeneous rays may be administered through several millimeters of aluminum. The coil is mounted on a substantial pedestal, with a milliamperemeter and valve tubes carried on separate pedestals attached to the coil frame.

A white marble switch-board, carrying moving coil type volt and amperemeters are provided, with all necessary control switches, regulating rheostats, etc. A selecting switch enables either a mercury or electrolytic interrupter to be used at will.

Either shunt or series connection of resistance may be employed and terminals are provided so that a two-way foot switch, controlling the pilot lamp and the main circuit, may be used if required. The speed of the interrupter can be varied within wide limits.

All rheostat studs and live parts on the switchboard are completely covered in glass cases so that there is no possibility of any accident from shock. A small distribution board is attached to the wall carrying all terminals, fuses, etc., and from this are made the various connections to the coil and interrupters. This is connected to the coil by means of a multiple conductor flexible cable, in protective sheathing.

The mercury interrupter is designed to deal with the heaviest currents without overheating. A centrifugal pump projects a stream of mercury against two insulated copper blades, connecting them at every half revolution. These two copper blades are in series with the coil circuit and thus the primary current is rapidly made and broken, twice in each revolution of the motor. By means of a simple adjustment of one of the blades the period of making current can be varied at will. The dielectric used is coal gas and the interrupter can be run for long periods without the mercury requiring cleaning.

The electrolytic interrupter has five points of heavy gauge platinum wire. The points are adjustable and by means of the change-over switch on the portable switchboard, it is possible to use them singly or any number in parallel. This interrupter is capable of handling efficiently a current of 150 amperes, thus enabling the very heaviest discharges to be taken from the coil.

Lightning completely volatilized 150 feet of wire on the Santa Fe-Cerrillos, Texas, telephone line last fall, and burned the two poles at the ends of the wire, while three intermediate poles were left uninjured.

AN AUTOMATIC ELECTRIC WELDER OF UNUSUAL CAPACITY.

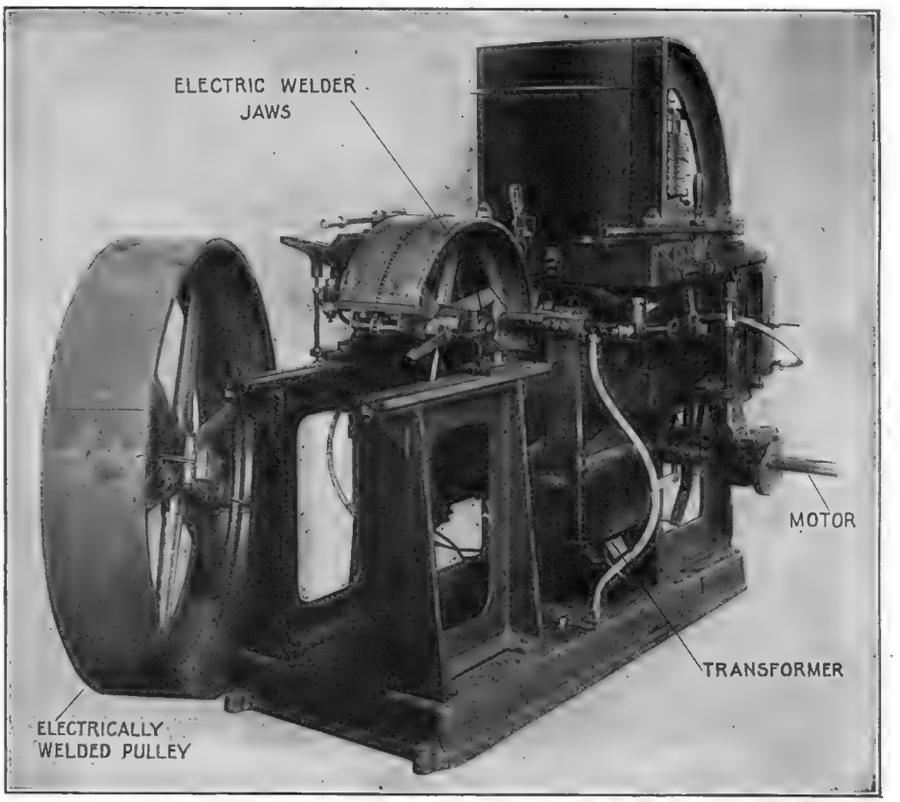
To the average mechanical man the word *automatic* implies a machine designed to perform a cycle of operations on a part or parts of a given size, and working within a very limited range of adjustment. It will come as a surprise to this average man to learn of a machine which will take circular work ranging from 12" to 60" in diameter without in the least affecting its automatic features of operation.

The machine referred to is a specially built electric welder used for welding steel pulley fillers to the rims. This welder, in addition to its unusual range of automatic operation, is notable for the small number of moving parts and the simplicity of the mechanical principles on which those parts operate.

Two complete and separate electric welding equipments are provided, one on each side of the center of the pulley to be welded (see figure) and each makes 60 welds per minute with a motor drive and automatic switch.

The welding mechanisms move from each other to give a clearance of 12" between the welding points. They are water cooled and will operate within a space of 2½" radial from the center of the arbor. Feeding and stopping are automatic, the feed device being adjustable from ½" between welds, up to 3" or more, as desired. The stops will automatically trip off and halt the operation of the machine when it reaches the separation strip on the pulley.

The floor space required by this remarkable machine is 50x66 inches and the weight is approximately 3,500 pounds.



An Automatic Electric Welder Adapted to an Extraordinary Range of Work. It Welds Steel Pulley Rims to Fillers Having a Diameter of from 12 to 60 Inches. A Motor Operates the Automatic Switches and Chucks.

A BUSY MAN.

The telegraph agent at Millrift, Pa., J. F. Maloney, is a very important man in his community. He holds no less than seventeen positions of trust or public interest, and they are so diversified that we name them: Telegraph agent, town clerk, postmaster, school-teacher, public appraiser, secretary of the board of supervisors, member of improvement society, proprietor of general store, proprietor of mail order house, railroad ticket agent, express agent, baggage agent, boarding house proprietor, real estate operator, milkman, insurance agent, flagman. It is not stated whether there is any other man in Millrift.

Research As a National Duty

ALMOST important and timely discussion in *Science* by Dr. Willis R. Whitney, of the General Electric Co.'s research staff, emphasizes the importance of material research and lays great stress on its necessity to any people who are ever to become a leading nation or a world power. Dr. Whitney says in part:

"I have called it material research because I wanted to exclude immaterial research. I class under this head pure thought as distinct from thought mixed with matter. It is worth while making this distinction because, from the youngest to the oldest chemist, it is not always recognized. It is very natural for us to think we can think new things into being. Chemistry has advanced only in proportion to the handling of chemical substances by some one. When the study of our science was largely mental speculation, and the products and reagents largely immaterial, like fire and phlogiston, we advanced but slowly. Ages of immaterial research for the philosopher's stone only led to disappointment. Successful results in modern times came from following nature, learning by asking and experimenting, reasoning just enough from one stage of acquired knowledge to ask the next question of materials.

"In speaking of research, I do not mean to confine my thoughts to the chemists and their knowledge and literature, but rather to that science which is back of chemistry. We may call it natural science, if we are careful. It includes, for my present purposes, all philosophy based on measurable facts. Psychology and therapeutics come under this head; so do electricity and medicine, anatomy and physics, chemistry and biology. These are inquisitive sciences, where the answers come from *asking questions of nature*. If I can leave with you even a faint impression of the importance of new knowledge, the strength to be gained from its acquirement, and the pleasure in the process itself, I shall feel repaid.

"So much useful pioneer work in all fields has been done with simple material equipment coupled with good mental equipment, that it almost seems as though this was the rule. The telegraph and telephone started with a few little pieces of wire wound by hand with paper insulation. The basic work on heredity was carried out by an Austrian monk with a few garden peas. The steam-engine came from the kitchen fire, and wireless from the tricks of a little spark gap. There was, however, the same general kind of mind behind each one of these discoveries, *the mind of the trained inquirer*.

"Exactly the opposite belief is also quite common—that great advances are made by sudden flashes of thought through the mind of some lucky and presumably unoccupied individual. If this were so, there would be little need for the high degree of training which is necessary for almost any scientific service in our day. We may find a simple illustration of this point in organic chemistry. We know that the artificial production of important chemical compounds, such as indigo and rubber, has been accomplished. But how many of us even begin to realize the training that was necessary and the research that had to be done before success could be claimed. The Badische Company spent seventeen years completing the indigo work after the first synthesis, *and expended about five million dollars before a pound was put on the market*. I might say that without at least fifty years of work by thousands of research chemists, neither problem could have been solved.

"I would also be right in saying that if you removed from that structure even a part of the purely theoretical work, such as that where organic chemists spent their lifetimes testing the compounds for the imaginary double bonds of the hypothetical benzol ring, such synthesis would not have been brought about.

"Since 1856 the same seeking for knowledge by renewed groups of such men has been continually going on in many foreign laboratories, but is only slowly being taken up in our country. Is it not time that we awakened to the fact that, as research chemists, we are still in our infancy? If we are ever to be a leading country in industrial chemistry, research is absolutely necessary. If such research is done elsewhere, then the major part of the advantage will lie elsewhere also.

"This is one of the most difficult points for an American to recognize. Forests may be leveled by a brawny arm with an ax, canals may be dug with a dredge, but practical science needs knowledge and *training, and always more training*.

"Excepting one or two minor attempts, we Americans have made almost no study of the fixation of atmospheric nitrogen. I want you to realize the varied and expensive researches, mostly carried on abroad, which were required to reach the present position of the nitrogen question. There were in Germany and, by German capital, in Scandinavia, several direct oxidation processes carried through the experimental to the practical commercial stage. The Schoenherr process is one of these, the Birkeland and Eyde process another. The direct combination of nitrogen and hydrogen to form ammonia has been successfully developed in the German Haber process, and the cyanamid process, with all its products from carbide to ammonium nitrate, was developed in Germany. There they used not only the peculiar reactions of calcium carbide with nitrogen, but the production of the nitrogen from liquid air, the reaction between water and cyanimid to form ammonia, and then an oxidation process for obtaining the nitric acid. The oxidation of ammonia to nitric acid by such methods as the Ostwald process has been studied by many investigators since 1830, and several different schemes are now in use abroad.

"Conditions are similar in all the applied sciences. The accumulated knowledge in any field is already very considerable, and to get on to the firing-line of useful work one must go up past the baggage-train of knowledge and experience. There is something in the blood which makes an American naturally hate preliminaries. It will be a great day when we see how important preliminaries are. The young student of mechanics thinks he could have devised the steam turbine if it had not been done before his day, but when he comes to study the problem as it has actually been developed, he finds the same old kinetic theories, differentials and integrations which he spurned as too theoretical when he sought a short road to engineering.

"I want you to realize that in America we are going ahead in future at a rate dependent entirely upon our preparation. Laboratories are a relatively modern thing. In most of the sciences they are a development within the lives of men now living. I want you to see that we must be foremost in systematic, organized research, or we will be distanced by other countries which already well recognize the value of new knowledge.

"When so much of our material welfare, the condition and extent of our manufactures, the quality of our agricultural ef-

(*Continued on page 780*)

NEW REGULATOR FOR AUTO LAMPS ON MAGNETO CURRENT

All autoists know that when they connect their electric head lamps to the magneto, that the brilliancy fluctuates in accordance with changes in speed of the magneto and engine. To obtain an even flow

Illustrating Comparison of Ordinary Magneto Head-Light, at Left, and Illumination Produced by New Magneto Compensator at Right.

of current at all engine speeds has been the problem of many accessory makers and the result as here shown is the outcome of one inventor. It is a reactance coil with a variable gap in its magnetic circuit and is entirely actuated by the current. It is especially adapted to the flywheel type of magneto. The coil is arranged to work the lamps in parallel, and with the proper selection of lamps, they burn up to almost their rated candle power when the car is running at the slowest speed. At low speed the gap in the magnetic circuit is open and the inductive or resisting effect of the coil is negligible, being limited to the ohmic resistance of the wire constituting the winding of the coil.

When the speed of the engine is increased the voltage and the period of the magneto are increased, the effect of which is to increase the voltage and the current of the lamp circuit. A very slight increase in the current causes the gap in the magnetic circuit to be shortened by magnetic attraction, thereby increasing the magnetic flow in the core and increasing the inductive or resisting effort of the coil. (The energy from the magneto is in the form of alternating current, as developed in the Ford magneto, for instance.)

The greater the speed of the engine, the shorter the gap will become and at the highest possible speed it will be almost closed, thus choking or partially neutralizing the voltage generated by the magneto.

This Automatic Impedance Regulator Causes Lamps on Auto Using Magneto Current to Be Steady at All Speeds of the Engine.

In case one lamp becomes broken the other is protected and will continue to burn the same as if both lamps were receiving current. The manufacturers claim that the lamp cannot be burned out by the racing of the engine with this device in use.

Baron Münchhausen's New Scientific Adventures

By Hugo Gernsback

Martian Atmosphere Plants

GAZING thru my faithful three-inch telescope upon the dazzling plains and extinct volcano ranges of the Moon, often set me wondering in the past. Everything appears dead, everything spells desolation on a tremendous scale. No atmosphere seems to exist, no green or brown patches greet our eyes from which we might infer that the moon harbored vegetation. Nothing but brilliant, white uniform wastes. For there cannot be vegetation, as we understand the term, where there is no atmosphere to support the plant life.

But was it always thus? Geological science here spells an emphatic NO. Eons upon eons ago the moon must have had an atmosphere as has our earth. Gradually, due to the very small gravitational attraction of the moon, its air must have slowly left it to vanish into space, never to return. A slow process, to be sure, but steady nevertheless.*

What dramas must have been enacted on our now dead satellite before the last creature died, gasping its last breath! What tragedies there must have been enacted before the last intelligent creature—if there were such—finally bowed to relentless nature. Did these creatures put up a fight against certain extinction before they accepted the inevitable, or did they let nature have her own way?

These were questions I frequently asked myself when gazing upon our dead companion world, questions which probably will not be answered for a long time, if ever.

I was more than pleased for this reason, that the moon, not being willing to tell me her riddle, another dying world—Mars—should volunteer certain information which might shed new light upon the question.

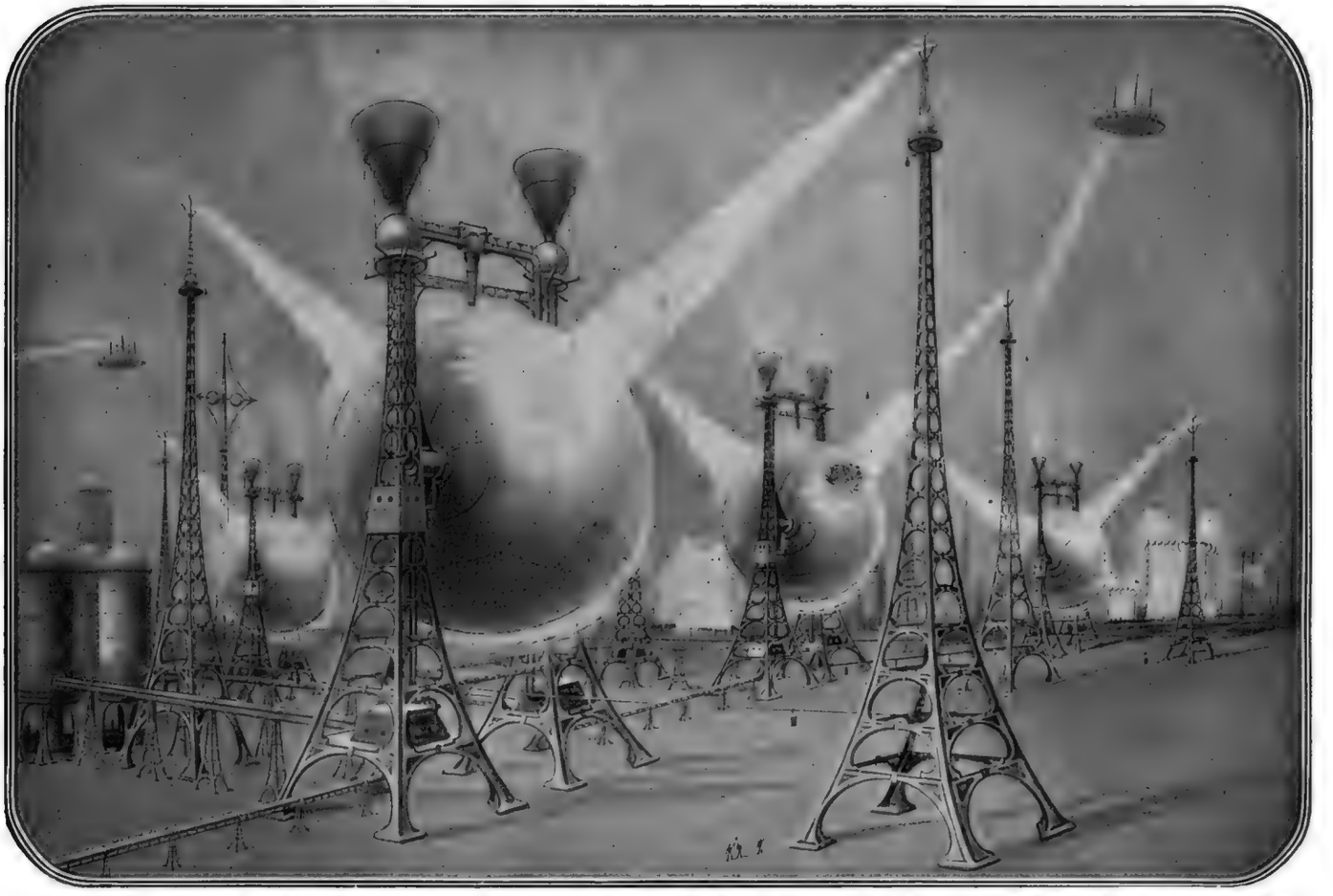
* * *

I had scarcely hooked up my latest Radium Amplifier to my Ultra-sensitive Radio receiver, and balanced the vibrant Photostat, when dear old Münchhausen's voice filled my laboratory through the loud-talking telephone relay. His voice came in clear as a bell and even I had difficulty in realizing that this voice did not originate a few miles away from my aerial, but some 80,000,000 miles distant, hurled through an unthinkably vast ether-ocean, a distance so great that the human mind fails to comprehend it.

"Greetings, my dear boy," Münchhausen's sonorous and sympathetic voice was sounding, "am rather lonesome this afternoon and anxious for a one-sided chat. If only I could hear that dear voice of yours, as I did when I was still on *Luna!* You see I actually have not heard a human voice for days. Professor Flitternix and I are becoming so *Martianized* that it is no longer good form to talk aloud when it is easier to converse by thought transmission. We are so proficient in the (to us) new art, that it is now a rare occasion when we utter a word. This is more an ancient habit than a necessity, because we can converse ever so much faster by thought transference than by spoken words. But our barbaric custom still clings to us, and for that reason it does me real good whenever I have occasion to talk to you! If only you had a sufficiently powerful sender to talk back to me. Ah! would that not be delightful? But on second thought, who knows that it is not better as it is? You might ask me too many pertinent questions. And besides, we have not been on Mars sufficiently long to know much. We are still very VERY young puppies, blinking uncomprehendingly about us in a wonderful and ancient world, with far too few senses to appreciate all that continuously goes on about us.

What we see and hear I am convinced is insignificant as to what we cannot see and cannot hear. This was thoroly demonstrated to us only to-day.

Flitternix and myself, accompanied by two of the Planet Governor's attendants, were walking about the elevated streets of the Capital City, taking in the sights. We



Our Flyer Had Now Come to Within Several Hundred Yards of One of These Wonderful Air Plants, and Circling Around It, We Could See How Tremendous Its Size and How Marvelous the Minds That Built It.

*NOTE.—It is assumed that the exceedingly attenuated "atmosphere" which Münchhausen reported during his visit to the moon, is of comparatively recent origin; it is probably of a volcanic nature.

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OUR air-less moon gives us a graphic lesson of what happens to a world when it grows old. The moon doubtlessly once had an atmosphere as has the earth to-day. Its atmosphere has long since vanished into space. What will our descendants do ages from now, when their air supply dwindles down to nothing? Will they generate their own air, as Baron Münchhausen tells us the Martians do? We think you will like this instalment. It contains several novel ideas.

had not gone far when we came to an open "square" which, however, was not square but round. All about it were towering structures, but there did not appear to be any living being in the square itself. We were to ascertain the reason at once. The floor or ground of the square was steel gray and polished. It was perfectly round and measured perhaps 600 feet across. In the center was what appeared to be a transparent TOS structure, having the form of a sharp cone. As we walked up to the circular square, one of our companions motioned us to stand still. The other Martian then walked on rapidly and as we watched him the most remarkable phenomenon took place.

Ten feet from us he suddenly assumed a hazy appearance and in a few seconds had become almost transparent. We could still see the outline of his body for a few seconds, and then he vanished entirely and completely before our very eyes. He had dissolved into nothing! The square appeared empty and deserted and we could look right across it. If anything ever appeared deserted, that square certainly did. After a few minutes our companion suddenly appeared again in exactly the same fashion as he disappeared. We first saw the hazy outline of his body, then he became transparent and finally he assumed his former shape. Seeing our utter amazement, our two companions tried to convey to us that what we thought an empty circular spot, was in reality a public health establishment. Moreover our attendant's daily duty was to start its mechanism at a certain hour after sunrise, after which the establishment was open for all during the entire day until sunset. Indeed while we were still looking on, myriads of Martians appeared from everywhere, walking briskly into the circular square, all of them vanishing before our eyesight as soon as they had walked in a few paces.

In they walked in never ending streams, to be swallowed up in the blue air, only to reappear a few minutes later. Still the square looked empty and deserted, despite the fact that thousands of Martians were actually walking across it—a phenomenon as uncanny as it was astounding. Those that emerged looked flushed and invigorated, for seemingly whatever was happening to them must have had a decidedly vigorous effect upon their systems.

Upon a gesture from our two attendants we in turn marched in. The experience was indescribable. No sooner had we set foot onto the bright steel-like metal surface than we felt a curious but very powerful vibration, which increased as we walked towards the TOS cone in the center of the square. We seemed to tingle and "itch" from head to foot and our heads "swam." I was watching Flitternix closely. Slowly his form grew less distinct, then hazy—now he was almost transparent and I could just make out the outline of one of our companions, right thru Flitternix's body. In another second he had vanished completely! I talked to him, then shouted. Not a sound left my lips. Still my lips were there, I knew that because I licked them. I looked down where I knew my feet to be, then I waved my arms in front of my face. Nothing whatever could be seen. My entire body had become astral. I knew I had not dissolved for I still had feet and could think, altho but very vaguely. I then tried to converse with Flitternix by thought transference, but the experiment proved to be a failure. Whatever influence surrounded us, no doubt deprived us of sending thought-waves across the space separating our invisible bodies.

Shortly we came abreast the TOS cone and as we approached it, tremendously powerful waves of unknown properties engulfed us and vibrated every atom in our bodies, shaking us from head to foot. Our bodies became insufferably hot from the titanic energy set loose upon us and when we finally emerged at the other side of the square, having become ourselves once more, we were almost exhausted from our new experience. This effect, however, wore off in less than one minute and we could not help noticing that we felt wonderfully invigorated, a feeling of undescribable well being and strength permeating our bodies which had been tired and lax before.

Now for the explanation. As soon as we set foot onto the metallic flooring our bodies were vibrated at a tremendous rate of speed, the wave motion being much greater than the velocity of light waves. This explains why our bodies became transparent to our eyes, which become blind as soon as the wave motion goes beyond that of light.

A similar analogy is had with our hearing. Thus it is well known that the human ear cannot hear any sounds, once sound waves go beyond 38,000 vibrations a second. Of course, there is still sound, but the mechanism in our ears is such that we no longer hear. In other words, we are "deaf" for all sounds above 38,000 vibrations per second.

Exactly the same holds true in optics. Take for instance red light rays; these vibrate with a frequency of 395 billions per second. The frequency of green rays is 569 billions per second, violet rays 764 billions per second and so on. Ultra-violet rays which follow the violet rays closely, already are invisible as is well known. Our eyes can no longer perceive their presence, altho a photographic plate—more sensitive to these rays than the eye—can "see" ultra-violet rays, as readily as our eyes see red or green light.

Of course, the process of making our bodies invisible or rather transparent, was not vibration alone. Certain TOS current effluvia were let loose upon our bodies simultaneously and this effluvia, combined with the TOS current vibratory-waves, produced the result.

Making the Martian bodies transparent is not a spectacular trick, but it is rather the direct result of what happens when the bodies are treated in a certain necessary manner.

On Mars, where everything is carefully regulated for the benefit of the entire populace, it had been ascertained thousands of years ago that the greatest enemies of all living creatures were the invisible germs and microbes infesting the bodies. In the early days of Mars, germ diseases were fought the same as you fight them on Earth to-day; that is, principally by certain serums injected into the veins. While such serums no doubt often save lives, they also frequently leave after-effects not wholly desirable. Of course, in the absence of anything better, serums will do, but they have been discontinued here on Mars ages ago.

The great and fundamental Martian idea is to *prevent* all germ diseases by absolutely killing ALL germs in the body each and every day. By vibrating the body at a tremendously high frequency and furthermore by treating it with certain TOS-currents, as already explained above, all germ life is annihilated within twenty seconds. Even powerful germs such as the Martian equivalent for anthrax, are killed in less than fifteen seconds. Hence no Martian ever dies of any possible germ disease, for he is compelled to have his body treated once every day, as long as he lives. Should he be unable to be treated publicly, the Martian authorities will then send a flyer with the necessary apparatus to his abode and treat him there once a day. Animals

(Continued on page 751)

IN THAT MARCH "E. E."

Now that the new year—all-glorious and unlimited in possibilities, is here, let us not waste the precious moments as they fly past—never to return. Count that day, hour or minute lost—forever—in which you have not learned something. Can you think of a better way by which to broaden your electrical and scientific knowledge than by becoming a regular monthly reader of THE ELECTRICAL EXPERIMENTER? *You say, perhaps, that—"I can get it from the newsstand, whenever I feel so inclined." But that is the way of disjointed paths to real knowledge. You must read the periodical that interests you not "now and then," but every month. The editors will always have "dug up" something during the previous month that will vitally interest you—whether your tastes run to electrical, radio, mathematical, or general scientific "news."*

Electricity and Life—A new aspect. By Dr. Frederick Finch Strong.

The Automatic Restaurant That Works by Electricity.

Baron Münchhausen will hold forth again on Martian wonders. By Hugo Gernsback.

Explosions and Explosives—Second paper of the new series—"Experimental Physics." By John J. Furia, A.B., M.A., F.K.S.

Staging a Scientific Entertainment—with details for making all the electrical and chemical experiments. By Raymond Francis Yates.

The Latest in Wireless Apparatus—Timely, To-the-Point and Illustrated.

A Balanced Relay Burglar Alarm System—It Fools Them All. By Thomas W. Benson.

The Quenched Spark Gap—A semi-technical discussion on its action, design possibilities and limits. By Charles S. Ballantine, Radio Research Engineer.

The Calculation, Testing and Use of Radio Inductances, in 3 Parts—With direct reading curves of loose coupler inductances. Don't miss it, Radio-Bugs!

AN ELECTROMAGNETIC VIBRATOR FOR A. C. CIRCUITS.

A new electromagnetic vibrator for use on alternating-current circuits is here shown. The massage applicators for this

An Alternating-Current Vibrator that Operates Without a Motor.

vibrator may be attached so as to operate in either of two directions at right angles to each other. One produces a lateral or so-called Swedish massage stroke, and the other a percussion stroke. The device delivers about 200 vibrations per minute, operating on a 110 volt, 60 cycle alternating circuit. It possesses a number of unique features and has the faculty of resting very steady in the hand, contrary to motor driven types which exercise considerable gyration or turning effort. The applicator on this vibrator is energized in a sharp and clean-cut manner, thus rendering the work of the masseur extremely effective.

TELEPHONE RESTORES HEARING.

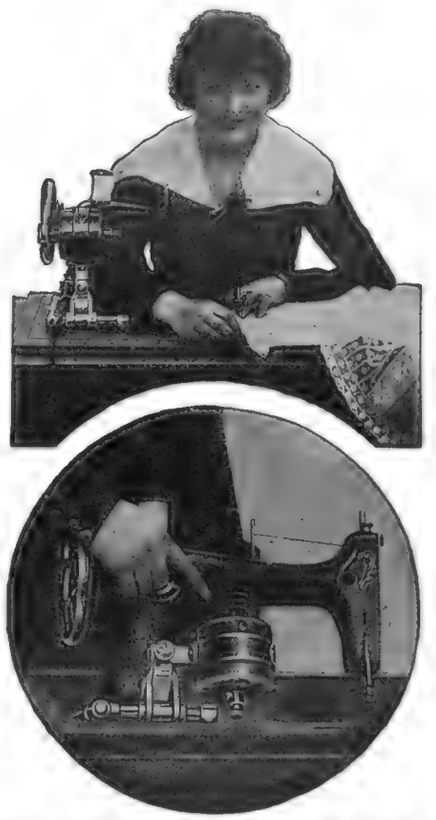
It is a well-known fact that the use of the telephone makes the sense of hearing keener. More marvelous still is the experience of Felix Bonvouloir, a deaf employee of a typewriter company in Hartford, says the *Telephone Review*. As a joke he went to the telephone to pretend to listen to the conversation of a friend, and, to his surprise and amazement, he actually heard his friend speak over the wire the first words he had heard for nineteen years! "I was terribly frightened," Mr. Bonvouloir is reported to have said later, "and for a moment did not know what to do. Then I realized that my greatest hope—to hear—had come to pass!" Mr. Bonvouloir was stricken deaf and dumb by an attack of scarlet fever when a baby, but had partly overcome his dumbness. He was graduated from the American School for the Deaf in 1905, after having been a pupil there for ten years. He is treasurer of the Hartford branch of the National Fraternal Association of Deaf Mutes, with headquarters in Chicago.

THIS ELECTRIC MOTOR FITS ANY SEWING MACHINE.

Several new and very desirable features are embodied in the new sewing machine motor illustrated. This new model fits any make of sewing machine—a distinct advantage. A thumb screw adjustment fastens two prongs securely into the belt holes of the machine and simple adjustments adapt the motor to any variation in height of handwheel or distance of handwheel from the sewing machine head. A child can easily attach the motor.

When in operation a strong tension spring holds the driving pulley firmly against the handwheel. When not in use the motor can be dropt to one side and the tension spring holds it beneath the head of the machine. The head with the motor still attached, can then be lowered into the cabinet of the machine, as will be evident from the illustration.

The choice of two types of speed controllers, giving six distinct speeds, can be had; either a foot controller, or a type which can be fastened right to the machine by means of an adjustable chain. One end of the chain is fastened to the treadle and the other to the frame work of the machine. This latter type in reality makes an electric sewing machine out of any old style ma-



At Last a Genius Has Brought Out This Electric Motor and Attachment Which Converts Any Foot-Power Sewing Machine Into an Electric in One Minute.

chine as the motor and rheostat control will remain fastened rigidly to the machine. When Milady has finished with her sewing she removes the detachable cord, places it in one of the drawers of the machine, lowers the head into the cabinet and everything is out of the way—no nuisance of always putting the motor and controller away.

The motor is universal and operates equally well on direct or alternating current. It can be instantly reversed to operate the sewing machine in the opposite direction.

HOW TO SMELL OVER THE TELEPHONE!

A young lady took down the receiver and discovered that the telephone was in use. "I just put on a pan of beans for dinner," she heard one woman complacently informing another.

She hung up the receiver and waited. Three times she waited, and then, exasperated, she broke into the conversation.

"Madam, I smell your beans burning," she announced crisply. A horrified scream greeted the remark, and the young lady was able to put in her call.

MERCURY DAMPING OF WAVES.

A new publication of the Bureau of Standards (Scientific Paper No. 289) is entitled "The Damping of Waves and other Disturbances in Mercury." It is sometimes of great importance that the mercury be prevented from freely vibrating under the actions of a disturbing force, and this is especially true when the mercury is used in accurate scientific instruments, as for example, mercurial barometers. It was found that the disturbances in the mercury is practically eliminated if it is subjected to a strong magnetic field, e.g., by placing it in certain po itions between the poles of a strong magnet.

ATTRACTIVE ELECTRIC WATER HEATER FOR SODA FOUNTAINS.

The unique electric water heater here pictured is designed to meet the average requirements for hot water in bar and soda fountain service. Its modern construction represents a marked advance over most other types of electric heaters designed for the same purpose it is claimed.

The fundamental principle on which all electric heaters operate is the same—heat generated by the passing of electrical current through resistance wires brings the water to any desired temperature, boiling point or under.

The one here shown operates on two distinct temperatures, high and low heat. High heat brings the water to the boiling point in about sixty seconds. The low heat keeps the water at a temperature just below boiling and its current consumption is so insignificant that it may be kept burning all day long, if desired, at trifling expense. Its economy is due chiefly to the fact that it consumes only 95 watts on low heat. One cent at the rate of five cents per kilowatt hour will operate the heater for two hours, on low heat. The tank holds one gallon of water.

In addition to providing an ever-ready supply of hot water at very much lower cost, this water heater is an exceedingly

Unusually Attractive Electric Water Heater for Soda Fountains. The Legend "Hot Drinks," Winked On and Off Automatically, Serves as a Mute But Efficient Salesman.

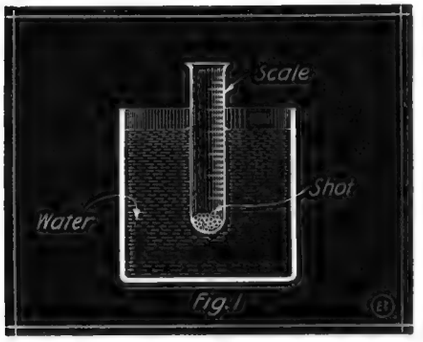
effective silent salesman. Its brilliant pilot light, flashing through the brightly colored lettering, "hot drinks," very often helps a slow customer decide what he is going to have.

Experimental Physics

By JOHN J. FURIA, A.B., M.A., Instructor in Physics and Science Master, Riverdale Country School

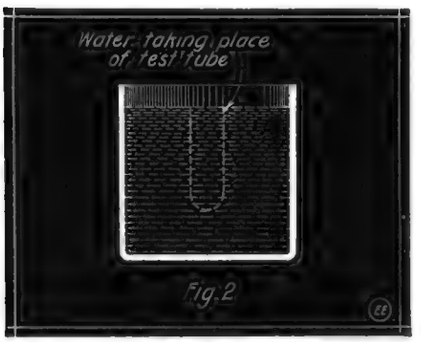
LESSON ONE.
Explosions and Explosives.
Introduction.

THE aim of this course of twelve lessons in "Experimental Physics" is twofold. First the writer wishes to impart to his readers certain fundamental principles, to acquaint them with some interesting physical phenomena (usually qualitative in character) and to show the operation and use of devices that are applications of principles of physics. Second the writer will feel considerably repaid for his attempts, if as a result of these lessons, he may arouse in the reader a love for science (for physics in particular); and a determination to study at greater length those principles which have made possible our present state of civilization. The titles of the several lessons will be only slightly indicative of their contents; and the experiments will be such as can be very easily performed by the layman in a short time and with little or no expense.



Simple Experiment With Glass Test Tube and Some Lead Shot, to Show Increasing Reactive Pressure at Various Depths in Liquids.

When a piece of wood is thrown into water, after penetrating to a small depth, it returns back to the surface. When a boat floats in water there must be an upward pressure of the water on it to balance its weight and prevent it from sinking. When the boat is more heavily loaded, it sinks more deeply, but the upward pressure must then also balance its weight. The following simple experiment will show us how the upward pressure varies with the depth of the surface on which it acts.



How the Water Fills the Space Previously Occupied by Test Tube, Fig. 1, Due to Upward Pressure Sustaining the Column of Liquid.

EXPERIMENT 1:—Place some shot in a test tube until the test tube just remains upright and floats in a jar or bucket containing a depth of about eight inches of water. (If no jar or bucket is available the wash tub or bath tub will do.) A paper scale, which can be made by laying a ruler along a piece of paper about half an inch wide by six or seven inches long, and marking the corresponding divisions on it, is then placed in the test tube to measure the changes in depth. Drop in some shot carefully until the tube has sunk half an inch from its initial position, being careful that the tube floats freely and does not touch the sides of the jar or bucket. On dropping in the same number of shot the tube will be found to sink another half inch. This can be continued until the test tube finally sinks. Our results lead us to the conclusion that the pressure on a submerged surface depends on the distance of this surface from the surface of the liquid. That is, the deeper down we go the greater is the upward pressure. A little thought will show that this upward pressure must be equal to the downward pressure of the water, due to the weight of the water above the surface we are considering, since when we remove the test tube its place is taken by some water, and the upward pressure will be balancing the weight of this water. We may then conclude that the pressure at any depth in a liquid is equal to the weight of the liquid above that depth.

The Principle of the Pneumatic Door Stop: the Piston "b" Can Enter Cylinder "a" But Slowly, Owing to Compression of Air Taking Place.

New Experimental Physics Series

IT affords us great pleasure to introduce to our readers Mr. John J. Furia, A.B., M.A., F.K.S., the author of our new series, "Experimental Physics," beginning with this issue.

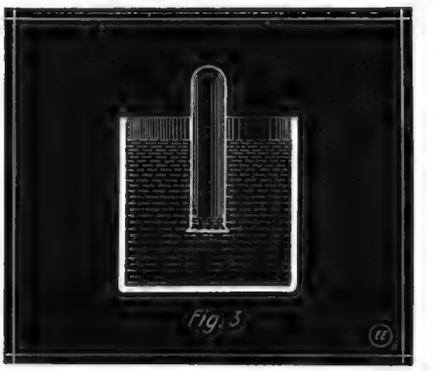
Mr. Furia, who is the physics instructor of a well-known college, is an indefatigable experimenter and has the rare gift of presenting dry subjects in a remarkably clear and interesting manner. He shows us the how and why of many things that puzzle us daily—things that we all ought to know, but which, as a rule, we do not. Furthermore, he shows us how to perform the experiments with simple means, available to all.

When we inaugurated our "Experimental Chemistry" Course, we mentioned the fact that no electrical experimenter could consider himself worthy the name without a fair knowledge of chemistry.

It is even more so with Physics. We are, as a rule, apt to be too one-sided, and by our lack of important knowledge, we suffer greatly. If you question this you need but think of Edison. Would he have invented the Phonograph and the Transmitter if he had not possest a thoro knowledge of acoustics? And where would his Cinematograph be, had he not studied optics? And how about the incandescent lamp which required a basic knowledge of heat and the atmosphere as well as mechanics.

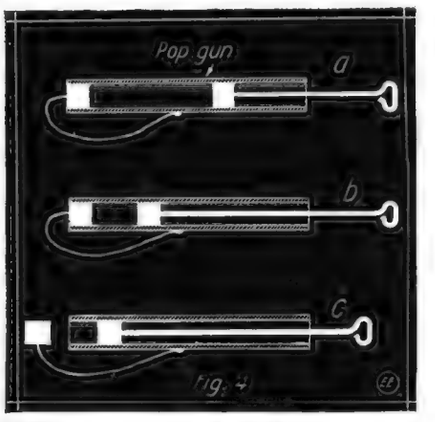
We are certain you will profit greatly by reading "Experimental Physics." Start to-day and see.

Experiment With Lead Shot and Two Sizes of Tubes, the Ball in Small Tube Being Forcibly Ejected By Compression of Air, as in the Air Rifle.



If We Invert the Test Tube and Press Downward on It, the Upward Reactive Pressure of the Water Will Be Found to Increase as the Depth Becomes Greater.

If one inflates a toy balloon and weighs it while full of air, and then lets the air out and weighs it again, one will find that it weighs less after losing the air. This shows that air has weight. (This will be treated more extensively in the lesson on the Atmosphere.) Carrying the analogy of experiment No. 1 to air, we see that there is pressure in the air and it is due to the weight of air above the surface we are considering. We are all familiar with the feeling of greater pressure as we descend below sea level. (Mines and the Hudson Tubes furnish a good example.) Rising above sea level we note that the air feels lighter. Gases as a whole act as air does, and it is this property of pressure which gases have, that we shall deal with in the subject of explosions.



Principle of the Ordinary Pop-gun: Increasing Compression of Air By Advance of Piston Finally Forces Cork Out; Stage "C."

EXPERIMENT 2:—Take the test tube of experiment 1 and inverting it, push it

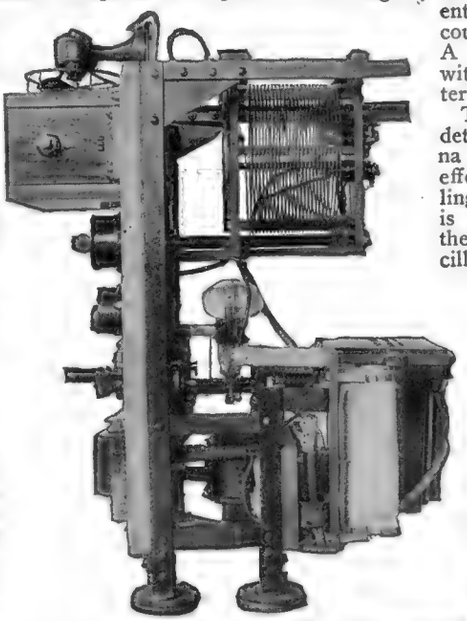
(*Continued on page 768*)

The Kilbourne and Clark Radio System

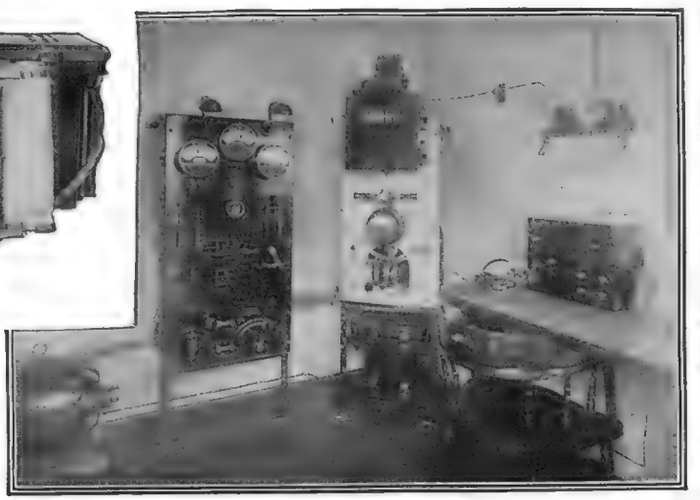
THE following description of the modern Kilbourne and Clark radio transmitting and receiving sets will be found very interesting to the radio experimenter as these transmitters operate on somewhat different principles than other existing types, inasmuch as they employ a mercury rectifier tube, or valve, linked into the oscillatory circuit for producing a pulsating current, which charges a high tension condenser, discharging thru a quenched spark gap. This novel form of transmitter was invented and perfected by Frederick G. Simpson.

Referring to the accompanying illustration, Fig. 1, shows the side of the transmitter: At the top is a small fan for cooling the two Simpson metal joint, quenched spark gaps, which may be seen in the lower end of the case under the fan. In the left end of this case is located the small mica condenser. Just under the left end of the case is mounted a special three-point instantaneous wave-changing switch, and immediately to the right is the hot wire radiation ammeter, reading 0-10 amperes. Below the are mounted the ammeter and voltmeter for indicating the exciting power.

Next in line is the motor field rheostat—the handle for tilting the mercury vapor valve and the generator field rheostat. (Fig. 2.) In the lower center is the magnetic motor starter, which operates automatically in response to the closing of the D.C. line switch in the lower right hand corner of the board. In the lower left hand corner is the A.C. switch.



Above:—Fig. 1. Side View of New Radio Transmitter Fitted with Simpson Mercury Valve and Quenched Spark Gap.



Left:—Fig. 2. Interior of Ship's Radio Room Equipt With New Kilbourne & Clark Wireless Set. Transmitter of 2 K.W. Capacity.

On the back of the board at the top, are placed the antenna inductances and just below, near the panel board, can be seen the Simpson mercury vapor valve. The closed core transformer is mounted on an auxiliary steel frame attached to the main frame, and beside the transformer is the resistances for the *keep-alive* circuit of the mercury valve. The rheostats can also be seen on the back of the board.

Fig. 2 shows the interior of a ship's radio room with a 2 kilowatt Simpson mercury valve transmitter, combination power control and battery charging panel and standard receiving set.

The apparatus is all installed in one corner of a stateroom of ordinary size. All the interior equipment is shown in the picture except the insulator in the roof thru which the leads run to connect with the antenna or overhead wires.

The receiving outfit, at the right, is of special construction and consists of a primary or antenna coil, wound with *Litzendraht* (stranded wire) and the variable switches controlling the number of turns included in the coil are provided with auxiliary dead-end cut-out contacts. There is also a variable air condenser in the antenna circuit, and a loading coil is provided for use in the reception of long waves. The secondary is absolutely untuned and consists merely of a coil of wire wound in a manner to eliminate, to the greatest possible degree, the distributed capacity present. The test buzzer is coupled to the ground lead. A crystal detector, fitted with potentiometer and battery, is employed.

The coupling between the detector coil and the antenna coil is variable, altho the effect of varying the coupling in this type of receiver is not the same as varying the coupling between two oscillatory circuits.

The ability to loosen the coupling is, however, useful in decreasing the strength of signals or in the reception of signals thru severe static, but under ordinary operating conditions the coupling is fixt at or near the maximum position. Both primary and secondary coils are provided with safety spark gaps.

The wiring diagram of the Simpson valve transmitter and its associated high frequency apparatus is shown at Fig. 3. The transformer D is a closed core, commercial type power transformer with a ratio of primary to secondary turns designed to give 4,400 volts between the terminals of the high potential winding, which is also provided with a neutral tap giving 2,200 volts to either terminal. The two high potential anodes I_1 and I_2 of the mercury tube E are connected to the two high potential terminals of the transformer. The bottom or cathode X contact of the mercury rectifier is connected thru a 220 ohm resistance F, to the ground side of the main condenser G and spark gap H. The other charging lead to the condenser is connected to the neutral tap of the transformer secondary. This side of the condenser is also connected to the antenna spiral coil K. The upper terminal of spark gap H, mentioned above, is connected to the outside turns of the antenna loading spiral K, at a nodal point of antenna potential.

The center turns of spiral coil K, are connected directly to the antenna loading coil M, the inductance of which is controlled by the wave-changing switch N_1N_2, when transferring from one wave length to another as desired. The antenna transfer switch O is used to connect the transmitting or receiving instruments with the aerial. One terminal of the condenser and one from the spark gap are connected thru the hot-wire ammeter W, to the station ground.

The tube is kept *alive* when transmitting by means of direct current thru a variable resistance and a fixt reactance coil; the negative side of the direct current line being connected to the lower electrode (cathode) of the valve and the positive side to the auxiliary anode Y, at the right of the cathode. As stated above, the tube is connected across the high potential leads of the transformer, D and is used to convert the 4,400 volt, 500 cycle alternating current to unidirectional, pulsating current, with which to charge the condensers. Arrangements employing two rectifying valves are explained at length in U.S. patent No. 1,199,213, given in the *Latest Patents* department of the January, 1917, issue of this magazine.

This transmitter utilizes the peculiar characteristics of the mercury vapor valve in assisting in a perfect quenching of the

spark gap. The spark gap is placed directly in the antenna circuit in parallel with a large condenser. The charging current is received from the mercury vapor valve, always in the same direction. There is only one oscillating circuit, i.e., the antenna circuit thru the condenser, but not thru the spark gap, in this system. This type is built in one, two and five kilowatt sizes. The efficiency of the transmitter is said to closely approach the theoretical maximum value. In operation, it is practically noiseless.

SPARKS FROM THE LOG BOOK.

By PAUL OARD.

First Ham:—Talking about static, a funny thing happened last night—my sister was combing her hair and sparks began flying from the comb and her head. Queer, wasn't it?

Second Ditto:—Yes, rather, sort of a *brush discharge*, so to speak.

WE'LL TELL MUNCHHAUSEN.

"M. Guzman of Paris has offered to pay $20,000 to the astronomer who first establishes communication with any planet other than Mars. M. Guzman's elimination of Mars as a wireless station in the competition he is promoting is based upon his belief that experiments made by American astronomers in Arizona prove that a wireless expert who talked with the Martians would be overpaid if he received 100,000 francs." Part of a recent news dispatch.

Evidently Monsieur Guzman never attended a meeting of some of the amateur wireless clubs which flourish in various parts of our fair land. If he had ever listened to a recital of long distance records as set forth by some hopeful who is struggling along on a 25 watt set, he would have raised the distance limit a few dozen planets, or have lowered his reckless offer of $20,000 to a sum which he could bear to part with in a hurry.

THE MEANEST AMATEUR.

There are some mighty mean fellows on this earth, but the one who put a fly in a fellow operator's receivers and then sat calmly by while the other heartily cursed static that only came in on one 'phone, and didn't even crack a smile, is probably going to be awarded the prize in the final reckoning

THIS IS THE LIMIT.

Some time ago, in the waiting room of a certain wireless telegraph company in San Francisco, the wireless men were passing away the hours by swapping long distance records. Finally, one chap who had been sawing wood industriously while the others chattered, spoke up. "Pooh for your long distance work—I worked Hong Kong on a ten inch coil."

"G'wan," rose the incredulous chorus.

"Fact—we were five miles out, bound home, and—" at which point the aforesaid operator hurriedly left the room, after which silence deep and profound fell over the assembly.

At the conclusion of which we will be pleased to recite "The Mystery of the Missing Hot House Roof—or—Where Did Willie Get His Condenser Plates?"

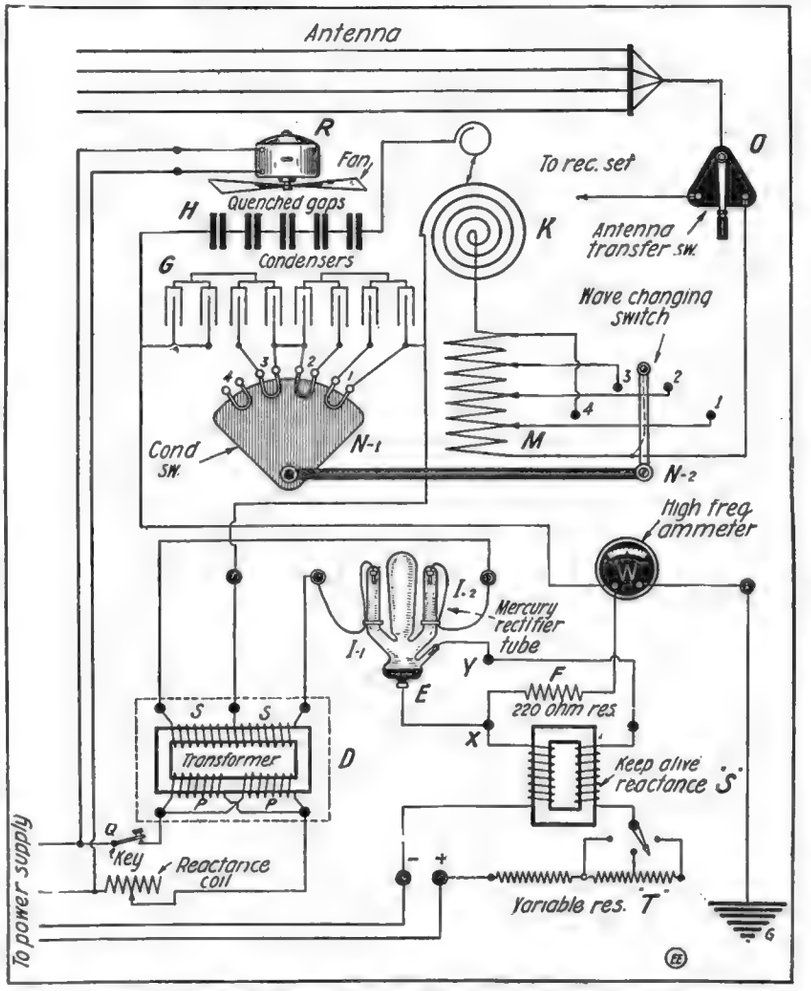


Fig. 3. Official Connection Diagram for the Kilbourne and Clark Radio Transmitter, With Simpson Mercury Valve, Quenched Spark Gap, Special Switches, Transformers, Quenched Gap Cooling Fan, Etc.

HELPFUL HINTS FOR BEGINNERS IN RADIO-TELEGRAPHY.

By Louis G. Barrett.

At the beginning of their career in *Radio-Telegraphy*, more than 75 per cent of the Amateurs know nothing about this subject. For the "would-be Wireless Man the following hints may prove useful.

First, you should have a good knowledge of electricity including magnetism and all ordinary phases of the subject. You should be able to secure this thru any of the modern electrical books which are on sale by most of the electrical magazines, and thru such books as "The A. B. C. of Electricity" and those books which show very simple electrical apparatus. Don't think these are printed just for small children! You will find you have learned something which will invariably be a help in the future if you have read a few of them.

After you understand the nature of electricity, secure a few good text-books on wireless telegraphy. Take, for instance, the "Text-Book on Wireless Telegraphy" by Rupert Stanley, which can be bought anywhere for $2.25. This book begins at the very base of electricity—"The Earth, the Atmosphere and the Ether," and thoroly explains all known facts of wireless telegraphy until at the close of the book, you find yourself capable of explaining the operation of the late types of apparatus used in government and commercial stations, with a knowledge of the "International Radio-Telegraphic Regulations." The first few pages of most all of these books contain a useful list of the many electrical books available, and from them you will be able to choose the ones which seem to best fit your line of the art.

By this time you should be well enough acquainted with *Radio-Telegraphy* to subscribe to a few magazines on the subject. Perhaps the best of these is THE ELECTRICAL EXPERIMENTER.

There are, of course, numerous other electrical magazines which will be found extremely valuable to both student and expert.

You should also send for catalogs of wireless apparatus from some of the most reliable manufacturers. Most of the leading companies you will find advertising in the columns of this journal.

You should shortly begin the construction of your own apparatus and of your station. Take plenty of advice from experienced amateurs, and follow the design of a good station you have seen. One of the greatest points is to take your time and never to rush the completion of any part of your equipment.

After your station is completed and you have secured good results it is very advisable to get a copy of "The Radio Communication Laws and regulations of the United States." You can secure this for fifteen cents by addressing the Superintendent of Documents, Washington, D.C. Study these pamphlets carefully and then go after a *Government License* for yourself and your station.

If you will keep everlastingly at it, studying the best books and magazines you can find, as well as watching for details whenever you visit any electrical or radio installation, you will, in a short while, find yourself very well versed in the art.

PROPOSAL VIA WIRELESS.

Mrs. Frances D. Thompson, en route from Glasgow to Superior, Wis., had blushingly to admit that she had received a proposal of marriage by wireless while speeding toward New York on the liner *Caledonia*. Mrs. Thompson, now a widow, had a sweetheart years ago in Frank MacIntyre of Superior. MacIntyre wrote a letter proposing marriage ten years ago. The letter was lost in the mails. This time MacIntyre took no chances and proposed by wireless. At-a-boy, Frank.

Watch for the March "Electrical Experimenter"! It will contain extremely valuable and original articles for every radio man.

United States and Japan Linked by Radio

From the Operating House as a Center, the San Francisco Aerial (at Left) at Koko Head is Carried on Five 330-Foot Masts to an Anchorage. The Japan Aerial (at Right) Extends From the Operating House Almost Due East. The First Two masts are of the Standard Sectional Type, 430 Feet in Height. The Aerial Makes a Span of More Than 2,000 Feet to the Top Edge of Koko Head, an Extinct Volcano, at an Elevation of 1,194 Feet Above the Sea Level; Here There was Not Room Enough to Erect a Sectional Mast, Only About Forty Square Feet Being Available for a Self-Supporting Structural Tower 150 Feet in Height. The Tail End Anchorage is Far Down on the Inside of the Crater. The Balancing Aerial, Which is Employed in Both Sets of Antennae, is on Self-Supporting Towers, Each of Which is 100 Feet in Height.

THE epoch-marking event of radio-communication between San Fracisco, U.S.A., and Funibashi, Japan, was recorded in these columns in the *January* issue. We present herewith an interesting view of the monster trans-Pacific station of the Marconi world-girdling chain of such stations as erected at Koko Head, Hawaii.

The American Marconi Company engineered the following units in the world chain: Trans-Atlantic stations at New Brunswick and Belmar on the New Jersey coast to send and receive messages to and from corresponding stations in Wales; sending and receiving stations respectively at Bolinas and Marshall, Cal., linking the Pacific coast with the Hawaiian stations, Kahuku and Koko Head (shown here), two similar stations in Manila, the Philippine Islands, and receiving and transmitting stations at Marion and Chatham, Mass., to connect in Norway with Stavanger and Naerbo.

From the operating house as a center, the San Francisco aerial (at left) at Koko Head is carried on five 330-foot masts to an anchorage. The Japan aerial (at right) extends from the operating house almost due east. The first two masts are of the standard sectional type, 430 feet in height. The aerial makes a span of more than 2,000 feet to the top edge of Koko Head, an extinct volcano, at an elevation of 1,194 feet above the sea level; here there was not room enough to erect a sectional mast, only about forty square feet being available for a self-supporting structural tower, 150 feet in height. The tail end anchorage is far down on the inside of the crater. The balancing aerial, which is employed in both sets of antennae, is on self-supporting towers, each of which is 100 feet in height.

The problems of construction at Kahuku which is now being employed both as a sending and receiving station, were not as great as those at Koko Head, altho the former is the largest wireless station in the world. From the power house the San Francisco transmitting aerial is supported by twelve masts, each of which is 325 feet in height; the Japanese aerial is supported by twelve masts, each being 475 feet in height.

The mast is made up of steel cylinders, constructed in quarter sections flanged vertically and horizontally and secured together by bolts. Stayed with steel cables, these stand in a concrete foundation. Surmounting the main steel column was a wooden topmast, the lower part of which is squared and set in square openings in the plates between the steel cylinders. The hoisting arms attached to the upper end were fitted with blocks and hoisting cables. Attached to these arms were chain hoists which supported a square wooden cage for the workmen, which was lowered or raised as the demands of the work required while the sections were being bolted together.

The stays, by means of which each mast is supported, are made of heavy plough steel cable, possessing great tensile strength. For each mast thousands of feet of this cable were used, great care being taken to see that the elastic extension of these stays was not so great as to result in the vibration of the mast during heavy winds.

Great quantities of wire were placed in the ground about the stations in order to provide an efficient earthing system or ground connection. In brief, a circle of zinc plates is buried in a trench, bolted together and joined to the wireless circuits of the power house by copper wire. Wires radiate from the zinc plates in the ground to a set of outer plates, from which extend another set of earth wires placed in trenches running the full length of the aerial.

The capacity of each of the generators employed in the stations of the United States-Japan circuit, with the exception of that at Funabashi, is 300 kilowatts. These generators are driven by 500 horsepower motors, except at Kahuku, where 500 horsepower turbines are used.

The distinctive feature of the aerials at the Marconi trans-Pacific stations is that they are directional, that is, the radiation of wireless signals in the desired direction is very much stronger than in any other. This control of the signals is a long step ahead in wireless communication. All of the stations are of the duplex type and can receive and transmit signals at the same time.

The automatic sending and receiving apparatus plays an important part in wireless communication between the Occident and the Orient. The sending machine somewhat resembles a typewriter and will make possible the transmission of more than 100 words a minute. Under the automatic system, ten or 100 messages can be filed at the same time at the office of the Marconi Company in Honolulu. They are distributed among the necessary number of operators and the dots and dashes punched in a paper tape by a machine. This tape is fed into an automatic sender and the signals conveyed by land line to Kahuku, where the dots and dashes actuate a high-power sending key, automatically energizing the aerial instanteously with the feeding of the tape in the station, thirty miles or more away. At the transmitting station the dots and dashes operate magnets of the high-power sending key in the main energy circuits and the signals are flashed to the points which the destination of the message calls for—either Marshall or Funibashi. If the message is destined for Marshall it will be received on a specially constructed dictaphone machine, each cylinder, as soon as it is filled with dots and dashes, being handed to an operator who will transcribe it into a typewritten message by means of a dictaphone machine running at normal speed.

For the present the Marconi United States-Japanese service will be confined to San Francisco, Hawaii and Japan. There will be two classes of service between San Francisco and Japan, a full rate or expedited service at eighty cents per word, a reduction of forty-one cents per word from the existing cable rates, and a deferred half rate service at forty cents per word, the lowest cable rate at present being $1.21 per word.

RADIO PROVES HOW "NEWS" IS DELETED.

Two striking examples of British deletion and suppression of news transmitted to the United States have come to light by comparison of identical war office reports filed simultaneously at Berlin for transmission to New York, the one by cable, via London and the other by wireless, via Sayville.

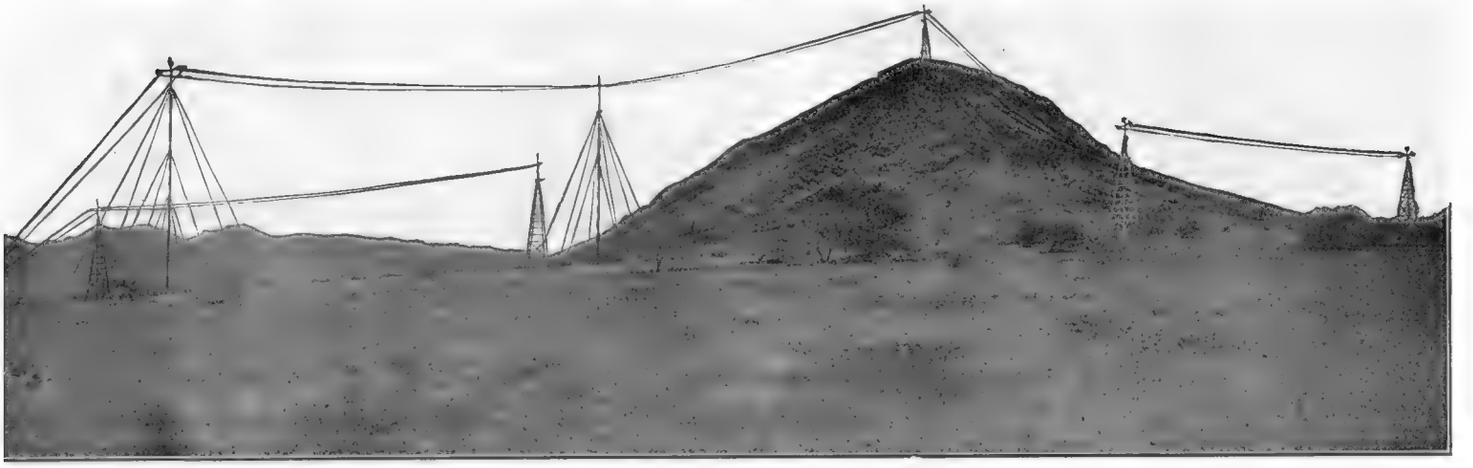
The first is a Bulgarian war office statement. The wireless and cable reports were alike except that from the latter, which past thru the British censorship, was omitted a paragraph announcing the destruction by a mine in the Black Sea of the Russian dreadnought, *Imperatritsa Naria.*

The second is a German war office statement. As transmitted by wireless, unedited by the British censor, it read:

"In a house-to-house engagement near the Sailly-Saillisel Church the French gained no advantage. Attacks launched there on a large front also failed."

The same statement received by cable after censoring read:

"House-to-house fighting near the Sailly-Saillisel Church brought the French small advantages. Otherwise attacks there on a wide front failed."



THIS JEWELER USES RADIO FOR BUSINESS AND PLEASURE.

The happenings in Mexico and on the border are nightly heard at the excellent wireless transmitting and receiving station here illustrated and belonging to Mr. W. O. Horner, a jeweler of Cleveland, Tenn. The progress of the European War, movements of ships, market reports and the standard time signals sent out by the powerful government station at Arlington, Va., are also heard. Mr. W. O. Horner is a wireless enthusiast and one of the most prominent wireless experimenters in the United States and has installed a McKnight circuit for the purpose of hearing both wireless telegraphic and wireless telephonic messages by means of the Audion. The office is not conducted as a commercial enterprise, but purely as an experimental station.

In the wireless telephonic communications between Paris, France, and the United States Government station at Arlington, which experiment was recently conducted, the voices of the singers were plainly distinguishable thru the receiving apparatus at Mr. Horner's desk. The voices of the different singers, tenor, alto, basso, etc., singing into the transmitters in Paris, and into the transmitters at Arlington, were as plainly heard in Cleveland as an ordinary conversation over the local telephone wires. Bits of conversation were also heard.

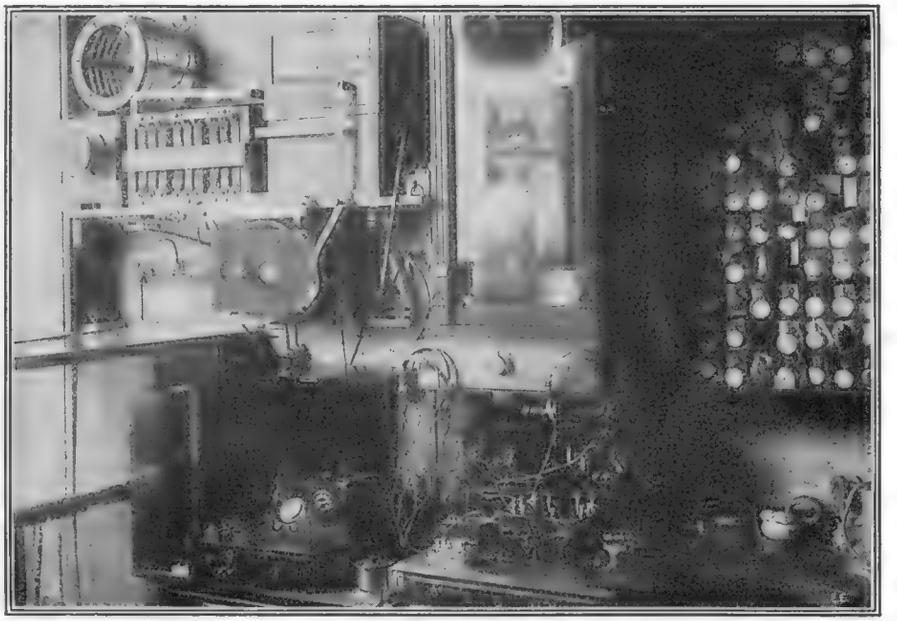
Mr. Horner had this confirmed by Captain W. H. G. Bullard, who in answering a query by Mr. Horner relative to the wireless conversation which was heard in the wireless telephonic apparatus here, said in part: "In reply I beg to advise that on the night referred to radio telephone conversation was transmitted from the Arlington station at about the time mentioned in your letter. This was undoubtedly what was heard in your receivers."

John J. Carty, chief engineer of the American Telephone and Telegraph Company, and who made the long distance wireless telephone possible, confirming the above, wrote Mr. Horner in part: "We sent out music and speech with our apparatus attached to the antenna at the naval wireless station at Arlington on a wave length of between 5,000 and 6,000 meters. This was undoubtedly the transmission which you picked up with your equipment."

Captain Bullard of the naval station at Washington sent a radio inspector of the United States Navy to inspect this station and to obtain photographs and blueprints of it. The inspector pronounced the station as one of the most efficient in the United States, and in his opinion, in event of war, the station would be taken over by the United States Government.

The Government will issue a special license to Mr. Horner for an experimental station which will permit him to operate on a much longer wave and send wireless messages for a much greater distance than at present.

Mr. Horner begins receiving war news about seven in the evening and continues until midnight. The big ocean liners in mid-ocean are heard with ease and he has succeeded in hearing the big station at Honolulu, the most distant station in existence, excepting Japan. Mr. Horner, like thousands of other jewelers owning a radio receiving set, has the pleasure of checking his window clock to the fraction of a second.



The Elaborate Radio Station Owned by an Enterprising Jeweler of Cleveland, Tennessee. He Receives U. S. Observatory Time, Accurate to the Fraction of a Second, Daily on His Radio Apparatus. The Jeweler Who Has Radio Time Service is the One Who Leads Today.

RADIO MAY AID U. S. FOREST SERVICE.

The U. S. forest service probably will use wireless telegraph in extending its communication system in New Mexico and Arizona as result of an experiment held on the Apache national forest in Arizona.

The forest service would not supplant its telephone and telegraph lines with wireless. That, of course, would mean unnecessary expense. Wireless would be used in connection with the present system. The present system provides communication between the district headquarters and all forest supervisors. Rangers, however, cannot always be reached by this means. Wireless would reach them.

Wireless may be used also instead of telegraph lines which the forest service plans to build. Cheapness of construction in comparison with wire systems recommends the wireless system for this use. Its maintenance would cost less also.

District Forester Paul G. Redington, speaking of the experiment, explained how a message was sent from the Baseline ranger station by wireless to a station at Clifton, Ariz., forty miles away. This is believed to have been the first wireless message sent from a ranger station in the United States.

The Baseline plant was installed by Ranger William R. Warner and Ray M. Potter at a cost of $75. The project was conceived by Ranger Warner. Mr. Redington was in the station when the message was sent. It was relayed by wire to the district headquarters here.

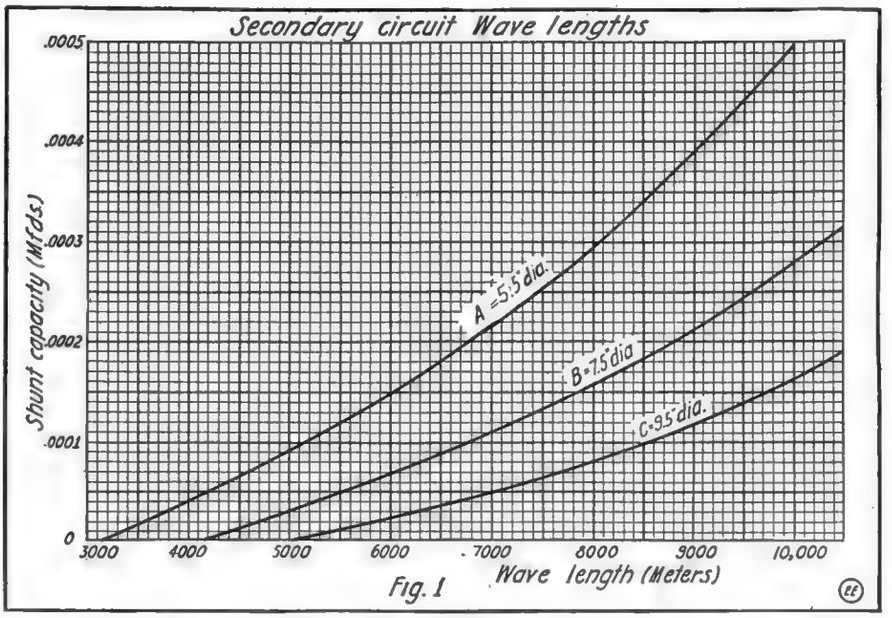
NEW U. S. ARMY WIRELESS STATIONS.

Authorization has been given for the erection of powerful radio stations at Laredo, El Paso and Fort Huachuca, Ariz. These will be a type similar to the wireless station at Fort Sam Houston, but of greater receiving radius, and will give the army a complete system of radio-communication along the Mexican border from Brownsville to the Pacific coast.

The Design of Large Radio Receiving Transformers

By CHAS. S. BALLANTINE, Radio Research Engineer

THE rapid development of continuous methods of antenna excitation and transmission on the longer wave lengths, has given impetus to the employment of the electron relay and long wave length apparatus in amateur circles. Probably the most important instrument used in this kind of work is the large transformer (loose coupler) used to raise the antenna constants to the required value. Up to the present time the design of this unit has received very little attention in technical journals and the construction is therefore attended in many cases with the uncertainties of the hit or miss principle. When it is realized that the region of 10,000 meters is practically unexplored, it becomes apparent that experiment should at least be preceded by a general mathematical analysis of the problem at hand. It is only in this way that satisfactory results may be expected. For the benefit of those experimenters who do not wish to make the required calculations, the following tables have been prepared, from which it should be possible to easily design an efficient receiving transformer.



The Above Curves Represent, Graphically, the Wave Length Variation to be Expected with Various Diameters of Secondary Winding and Shunt Capacities.

It has recently been brought to the attention of electrical and radio engineers* that the co-efficient before the radical in the well known equation for the fundamental wave length of an oscillating circuit,

$$\lambda = 59.6\sqrt{LC} \qquad [1]$$

does not have the same effective value for all forms of circuit. It is well known that in the case of a single vertical wire antenna with inductance L and capacity C, the fundamental or natural wave length is given by:

$$\lambda = 38.15\sqrt{LC} \qquad [2]$$

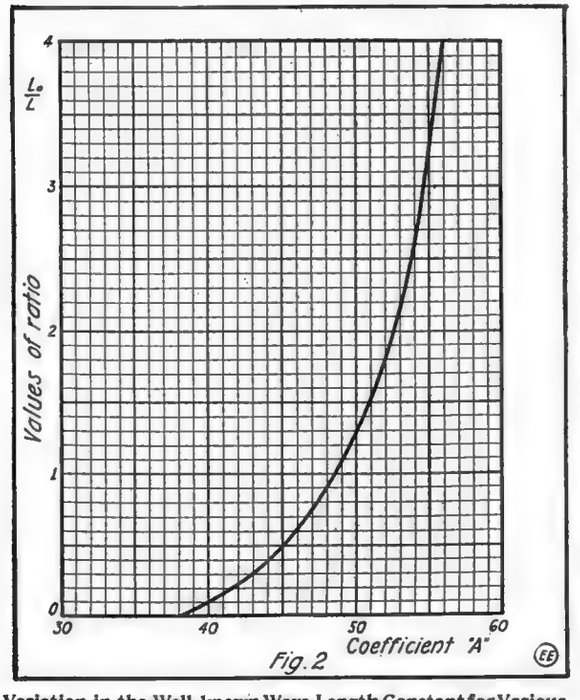
In the case of a circuit in which the constants are localized, such as that of the primary radio circuit of a transmitter, the equation becomes:

$$\lambda = 59.6\sqrt{LC} \qquad [3]$$

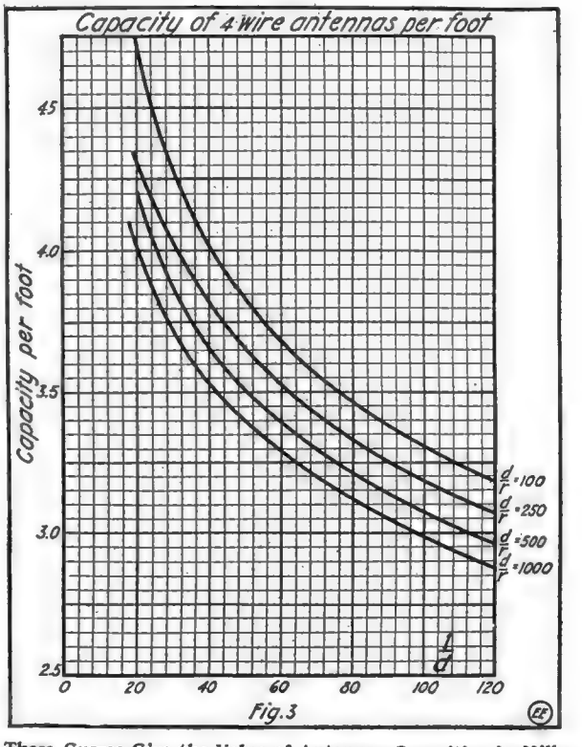
It is evident that for the case we are considering, i.e., that of an antenna system of distributed constants, grounded thru a loading coil of concentrated inductance, that the particular value this constant will assume will lie between these limits and its value will be determined by the degree of concentration of the constants of the antenna and load. This value is usually given in terms of the ratio of the load inductance, L_o to that of the antenna, L. In the curve of Fig. 2 the various values of the constant A are plotted against the ratio of L_o/L as ordinates. It will be seen that as the ratio increases the curve rapidly approaches the value 59.6, on which axis it has an asymptote. In the design of receiving transformers, then, suitable precautions must be taken to include the effect of the distributed character of the antenna constants. This is especially true of the design of small transformers when the ratio of L_o/L is small. However, in the present type of design this precaution is unnecessary as the value of 59.6 may be assumed without appreciable error at the wave lengths under consideration. The inductance in cms. required to load an antenna to a predetermined wave length is then given by the usual equation.

$$L_o = \frac{\lambda^2}{3552\,C} - L \qquad [4]$$

where L_o represents the inductance in cms. of the transformer primary, L that of the antenna in cms. and C, the antenna capacity in M.F. The inductance of the antenna itself is so small in comparison to the required inductance at L_o for the wave lengths of 10,000 meters that it may be neglected without giving rise to appreciable error. The inductance gained in this manner may be compensated for by a slight movement of the slider or primary switch.



Variation in the Well-known Wave Length Constant for Various Ratios Between Inductance of Antenna and Loading Inductance



These Curves Give the Value of Antennae Capacities in Millionths of a Microfarad (Mmfds.) Per Foot Length.

In designing a receiving transformer suitable for use on a certain wave length, the following method is suggested:

*Louis Cohen, *Electrical World*, Vol. 65, No. 5.

The amount of inductance required in the primary of the transformer is first calculated from the equation below.

$$L_o = \frac{\lambda^2}{3552\,C} \qquad [5]$$

Here λ represents the wave length to which it is desired to tune. L_o is the primary inductance and C the antenna capacity.

It is important that the antenna capacity be determined with some degree of accuracy as the effect of a slight increment of this factor is quite marked. The method of calculating the antenna capacity given by Howe is suggested as it is probably the most accurate in use at the present time. A short resumé of the basic principles of this method, as applied to the calculation of an antenna of four wires, is deemed of interest and will be included here.

Referring to the graph of Fig. 3, which gives the capacity in millionths of a microfarad (mmfds.) per foot length of antennae, the abscissa represent the values of the ratio of the length of the conductors (exprest in feet) to their separation. The various loci of the equation is (capacity C in mmfds. per foot length):

$$C = \frac{17n}{n\left(2.3026 log_{10}\frac{1}{d} - .31\right) + 2.3026\,log_{10}\frac{d}{r} - B} \qquad [6]$$

where n is the number of wires (in this case 4) and l is the length of the conductors separated the distance d. B is a function determined from the boundary conditions of the problem. See The "Wireless Telegraphists' Pocket-book," by J. A. Fleming, page 137; also article by Prof. G. W. O. Howe in "Wireless World"—London—Dec. 1914 issue, and an article by the same authority in "The Electrician"—London—page 859, vol. 73.

To calculate the capacity of a four wire antenna of any dimensions by the use of the above graph, proceed as follows: Determine the ratio l/d and locate the value as abscissa. After determining the ratio d/r, where r is the radius of the conductors, find the curve to use from this ratio and read the value of the capacity in MMFds. as ordinates. Now multiply this value by the length of the antenna to obtain the total capacity of the flat-top.

This value just determined is obtained on the assumption that the potential is not lowered by the proximity of the earth. As this is the case in practise, correction must be made to take this into consideration. To the equation which formed the basis of the calculation of the graph, is added the term $\frac{l}{4h}$ which is subtracted from the part below the line. Calling the former value of this term below the line X and placing the number $68 \times l$ above the line, set up the equation and solve for X.

$$X = \frac{68 \times l}{C} \qquad [7]$$

Now from this value of X just obtained subtract the correction term 1/h and solve for the capacity as before, or

$$C = \frac{68 \times l}{X - \frac{1}{h}} \qquad [8]$$

The lead-in capacity in the case of a rat-tail lead, may be approximated by calculating the capacity of a single wire at a distance equal to the average distance above the ground i.e., about one-half H, and a length l equal to the height of the antenna. The equation used is given below and contains the earth correction factor.

$$C = \frac{l\ (cms.)}{4.6052\ log_{10}\frac{l}{r} - .62 - \frac{l}{2h}} \times \frac{10}{9} \qquad [9]$$

This value is added to the flat-top capacity to obtain the total antenna capacity used in the equation. The author has appended a table of the capacity of various forms of antennae composed of 4 wires separated 3′ of 7-22 copper calculated from the above formulae. These are shown in Table 1 and are sufficiently accurate for the present purpose.

The amount of inductance to be added to the antenna determined from the equation (5) must be transferred into definite geometrical dimensions by means of the well known inductance formulas. The author has calculated the inductance of a number of forms of coils suitable for use as the primary of a transformer from the equations of Nagaoka and Rosa given in the Bulletin Bureau Standards, Vol. 8, No. 1. These are presented in Table 2.

The reader may either calculate his own inductances or a selection may be made from the values of Table 2.

The next quantity to be considered is the secondary circuit. The wave length of this completed circuit should agree with the period of the antenna system and the primary just designed. After a selection has been made of the diameter of the form on which the primary winding is to be made, reference should be made to Table 3, which also gives the inductance of various secondary coils corresponding to the dimensions given for the primary. It has been assumed that the secondary is about ½″ smaller in diameter than the corresponding primary coil. After the size of the secondary has been determined this completes the design of the transformer.

Fig. 1 represents, graphically, the wave length variation that may be expected with different values of shunt capacity with various diameters of winding. The practise of using a large capacity across the secondary inductance is not, strictly speaking, advisable in the case of the electron tube as the available potential obtained at the grid is lessened considerably and the strength of the received signals impaired. It is advisable on this account to build the transformer as large as possible as the mechanical difficulties encountered are entirely compensated for by the increased over-all efficiency of the apparatus.

Table 1—Capacity in Microfarads, including lead-in, of 4 Wire Inverted "L" Antennae. Wires Spaced 3 Feet Apart.

Height in Feet	Length Flat-Top in Feet 60	80	100	120	140	160	180	200
40	.00033	.00042	.00051	.00060	.00065	.00073	.00081	.00088
50	.00035	.00043	.00050	.00058	.00065	.00072	.00079	.00086
60	.00036	.00044	.00051	.00059	.00065	.00071	.00078	.00084
70	.00037	.00045	.00052	.00059	.00064	.00070	.00076	.00083
80	.00039	.00046	.00053	.00060	.00065	.00071	.00079	.00084
90	.00040	.00048	.00055	.00061	.00066	.00072	.00078	.00085
100	.00042	.00049	.00056	.00062	.00067	.00074	.00080	.00086

Table 2.—Inductance (cms.) of Transformer Primary

Inductance	Wire Used	Turns	Dia.	Length	Case
12 250 000 cms.....	No. 22 Enameled ..	500	6 inches	15 inches	A
20 750 000 "	same ...	500	8 "	15 "	B
30 850 000 "	same ...	500	10 "	15 "	C
48 138 700 "	No. 24 Enameled ..	1000	6 "	16 "	D
81 859 200 "	same ...	1000	8 "	16 "	E
121 801 000 "	same ...	1000	10 "	16 "	F

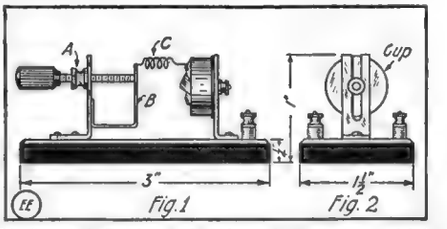
Table 3.—Inductance (cms.) of Transformer Secondary

Inductance	Wire Used	Turns	Dia.	Length	Case
50 200 000 cms.....	No. 28 Enameled ..	1000	5.5inches	15 inches	A & D
86 250 000 "	same ...	1000	7.5 "	15 "	B & E
133 700 000 "	same ...	1000	9.5 "	15 "	C & F

A HORIZONTAL MINERAL DETECTOR.

A suitable detector base is constructed from either hard wood or marble, 3 inches long and 1½ inches wide, and can be polished and finished to suit the builder. Two pieces of heavy brass, each 1¼ inches long and ⅜ inch wide are then made. One of these pieces is bored ¼ inch from each end and the holes should be large enough for an 8-32 machine screw to slip thru easily. The other piece is bored ¼ inch from one end, the drill being of the same size as the one used previously. The other end, however, should have a slot cut in the center and extending from the top of the piece, to within ½ inch from the hole in the bottom of the strip, as clearly shown in Fig. 2. Next we measure ½ inch from the bottom of this piece and at this point make a right angle bend. This completes the stand to hold the mineral cup.

Now take the strip with the hole in each end, and directly over one hole, a battery binding screw is soldered in place as shown in "A," Fig. 1. One-half inch is then measured from the other end, and a right angle bend is made. At this point a thin piece of spring brass is soldered, this being ¼ inch wide and 1¼ inches long. At the top of this piece a No. 26 phosphor-



Horizontal Design of Mineral Detector which Possesses Many Advantages. The Cup May Be Raised, Lowered and Rotated.

bronze wire is coiled into a spring. This is soldered to the spring brass to insure good connection. The adjusting screw and knob can be obtained for a very small price. The knob should be ¼-inch in diameter by ⅜ inch long, and the machine screw 1 inch long.

The mineral cup is a battery carbon cap, minus the carbon, having a bind post fastened to the back, so that it may be used to slip into the slot in the standard. A battery binding screw is used to clamp cup in proper position. The mineral may be held in place by some soft alloy, which supply houses sell for the purpose.

Three-quarters of an inch is measured from the end of the base, and at this point the standard is screwed in place, the wires being connected to each standard and brought down to the bottom of the base and then to the two binding posts.

These binding posts are made of two 8-32 one inch machine screws driven up thru the bottom of the base in back of the detector cup, or at any other convenient place. Two battery binding screws are used to hold the connection in place. Thus a very neat, rugged and sensitive detector is completed, the cost being insignificant.

Contributed by ROBT. S. QUIMBY.

PRACTICAL HINTS.

Switch points should be finished in white nickel, not nickeled and lacquered, as this makes a bad contact.

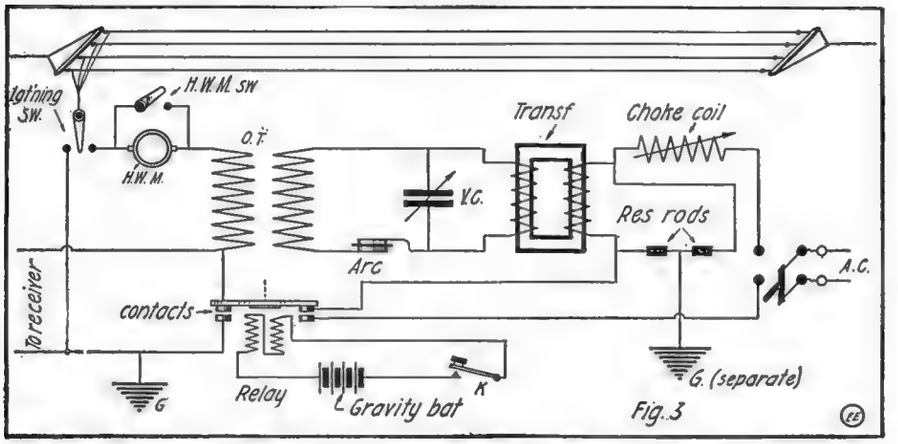
To realize the utmost efficiency in radio receiving circuits all joints must be soldered. Instead of using *bell wire*, employ stranded lamp cord or copper strip for all connections between the various instruments. Then don't kill all your good work by using a No. 18 lead-in wire—use a stranded or solid conductor equivalent to No. 4 B. & S. gage.

A Low Potential Arc Transmitter for Radio Stations

By Gordon C. Farmer.

THE transmitting arrangement I am about to describe has several features of interest. Namely:

1. It produces a sharp tone at the receiving station, using 50 or 60 cycle A. C. as a source of power.



Hook-Up for Radio-Telegraphic Arc Transmitter with Magnetic Key (Break-In) System.

2. A pure wave is emitted with the logarithmic decrement less than .2.

3. The wave length need not be over 200 meters.

4. A low voltage transformer is used, whereby leakage is reduced to a minimum.

5. It employs a reliable break-in system.

6. And last, but not least, the efficiency is high.

First I shall discuss the aerial. This is, of course, a very important factor, as several things determine the efficiency. The location, height, type and materials used are pertinent factors always to be considered. The location may be on a hill to advantage if there are no obstructions. Never put up an aerial in proximity to trees, as it is impossible to attain real good results near them.

For short waves a "T" type aerial is preferred, having a fairly large radiating surface, which is at the same time adaptable to short waves.

A "T" aerial, having a wave period of 200 meters, can be one hundred feet long and sixty feet high, with four wires spaced 3 feet apart at the center where the lead-in is taken off, and four feet apart at each end (Fig. 1). The reason for this is that the inside wires will not radiate properly if they are not spread apart a little, owing to the high potential at the ends.

There must be no sharp bends and all joints should be well soldered.

Stranded copper or phosphor bronze cable should be used and the lead-in must have a low high-frequency resistance. Four cables, similar to those in the aerial, wound together, will do nicely.

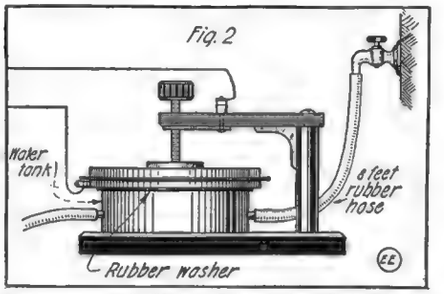
To obtain the required voltage for the arc, about 500 volts, a step-up transformer is necessary. It is similar to any closed core wireless transformer, except the secondary, which is wound in layers instead of pies. As most every experimenter understands the construction of a transformer there is no need to go into details.

Dimensions:

Core length.....11 inches
Core width.....5½ inches
Pounds of iron needed.....14 lbs.
Primary winding....6 lbs. No. 14 D.C.C. mag. wire
Secondary winding..7½ lbs. No. 22 D.C.C. mag. wire

The condenser:—A rotary variable receiving condenser of about .001 M.F. will do. However, the plates must be at least 1/20 of an inch apart. They are best immersed in castor oil to insure good insulation and also to increase the capacity (multiplying factor for castor oil is 5).

The power transformer charges this condenser, which discharges through some form of gap. In this case an arc is used. It is made up of two brass or copper discs 5 inches in diameter, with the arcing surface of pure (deposited or electrolytic) copper if possible. Care must be taken to have this surface absolutely true, except for a groove ½ inch from the outside edge on each plate.



Appearance of Water Cooled Arc Suitable for Low Potential Radio Sending Sets.

Fairly thick writing paper is inserted between the plates, with a pin hole in the center for the initial starting of the arc.

Now some arrangement must be provided for cooling the plates. A small can with an open top about the diameter of the plates is tapt in two places to allow water to circulate thru it. A rubber washer is placed between the edge of the can and the lower plate so as to make a closed compartment, allowing the circulating water to conduct the heat away without leaking.

By glancing at the drawing, Fig. 2, it can readily be seen how this is all arranged on a substantial stand. The knob at the top regulates the pressure on the plates; the right amount being determined by experiment. The flow of water can be regulated to suit the operator. However, it will be found that very little is needed unless the arc is used continuously.

The paper must be replaced every few hours when in steady operation; the time elapsing between changes depending on the kind of paper and also the amount of power used. Some varieties of paper, however, will last through five or six hours of actual operation. (We suggest the use of a fine grade of thin mica, which should last for months.—Ed.)

The oscillation transformer is preferably a pancake affair with the primary laminated. That is to say, three thin ribbons are used instead of one thick one, each separated by a strip of paper. This cuts the hysteresis loss down to a minimum.

Two secondaries may be tried, one on each side of the primary. This has been successfully used and the reader should be able to increase the efficiency of his set by following example.

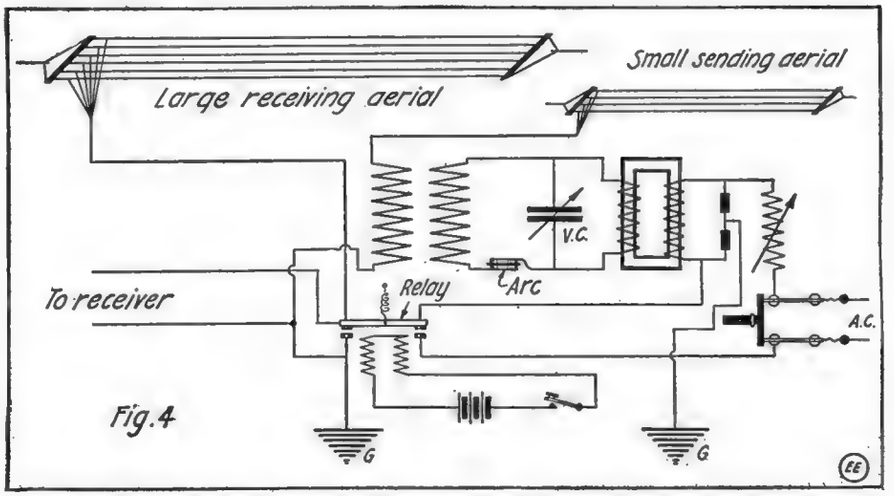
The advantages of using a relay as described here are twofold:

First, it eliminates the necessity of a heavy key.

Second, extra contacts on the key are done away with, permitting the operator to send unhindered when a break-in system is used.

The only bugbear is that a suitable battery must be provided to operate the relay; preferably a gravity cell. This relay should be wound to a fairly high resistance with two separate insulated contact switches arranged so that they are closed when the armature is attracted.

One of these relay contacts makes and breaks the current to the power transform-



Connection Scheme for Arc Transmitter Employing Small Transmitting Aerial and Large Receiving Aerial, Together with Magnetic Key (Break-In) System.

er and should be rather heavy. The oth-

(Continued on page 781)

The How and Why of Radio Apparatus

NO. 3—CONDENSERS.

From time to time we will describe one particular instrument used in either the radio transmitting or receiving set, explaining just how it works, and why. We have received so many requests from new readers asking for such explanations, that we have decided to publish this matter in serial form. In the course of several issues all of the principal transmitting and receiving apparatus will have been covered. The subject for the second paper is the CONDENSER.

THE electrical condenser may be likened to a hydraulic mechanism corresponding to that illustrated at Fig. 1, wherein we have two similar compartments, A and B, joined together by means of a valve, which may be turned so as to cut off one compartment from the other. If we fill the compartment A, with water, then we might consider the A side of the device as representing *positive* potential or polarity of one kind, and the B side of the device as representing *negative* potential or polarity of an opposite kind; the same as is the case with electrical condensers.

If the valve is now turned so as to allow the water in chamber A, to pass into the chamber B, then we may consider that the potentials have changed places, i.e., the B chamber now represents *positive* potential, while the A compartment represents *negative* potential. If the valve is properly regulated as to the size of opening, the water will return from chamber B, into chamber A at the left. This action will repeat itself a number of times, the water rising and falling alternately until, eventually, they come to rest, as shown in Fig. 1, at the extreme right, which we may take to represent *zero head* or the point of *full discharge* for the electrical condenser. And it will be noted also that there is no further movement of water thru the valve when this stage is reached.

The successive oscillations or swings of the water column as it rises first in one compartment, and then in the other, is indicated by the oscillatory curve at the bottom of Fig. 1. An electrical condenser behaves in a similar manner when it is discharged thru a suitable circuit and the potential and current oscillates or swings back and forth thru numerous positive and negative waves as seen. Only oscillations to speak, until the wave train is complete, as indicated by the extended section C.

If the valve in the hydrostatic apparatus is made to have a sufficiently small opening, then the oscillations will not occur, but the liquid will rise slowly in the opposite compartment in a single surge. This corresponds with the action of the electrical condenser, in which case, if the discharge occurs thru a long thin wire then no oscillations will take place, but the condenser discharge current will take a longer time in which to die away to zero (in a single surge); if discharged thru a relatively shorter and thicker conductor, then the condenser will discharge more quickly and in an oscillatory manner. Whether or not a condenser discharge will be oscillatory or non-oscillatory may be determined by inspection of Thompson's equations:

$$R^2 < \frac{4L}{C}\left(\begin{matrix}\text{oscillatory}\\ \text{discharge}\end{matrix}\right);$$

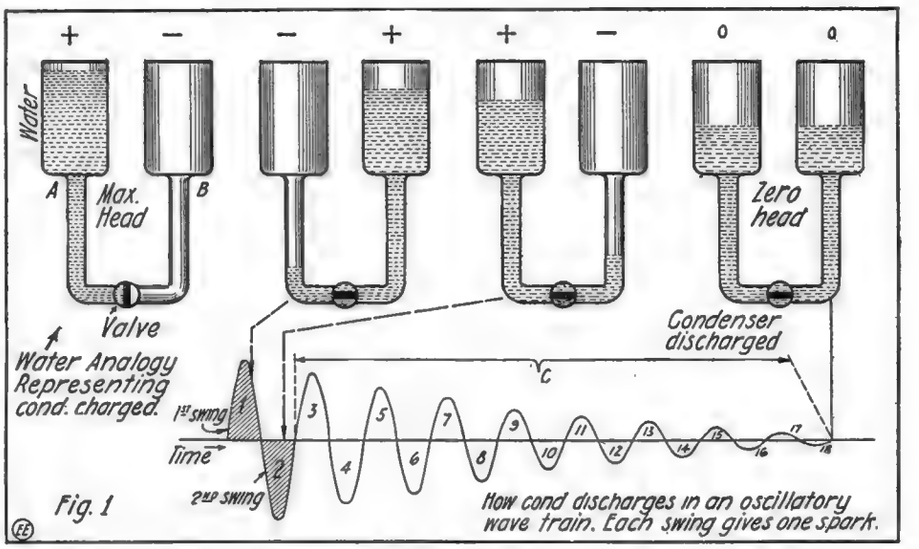
$$\text{Or } R^2 > \frac{4L}{C}\left(\begin{matrix}\text{non-oscillatory}\\ \text{discharge}\end{matrix}\right)$$

Where:—L is inductance of circuit; C its capacity and R the resistance.

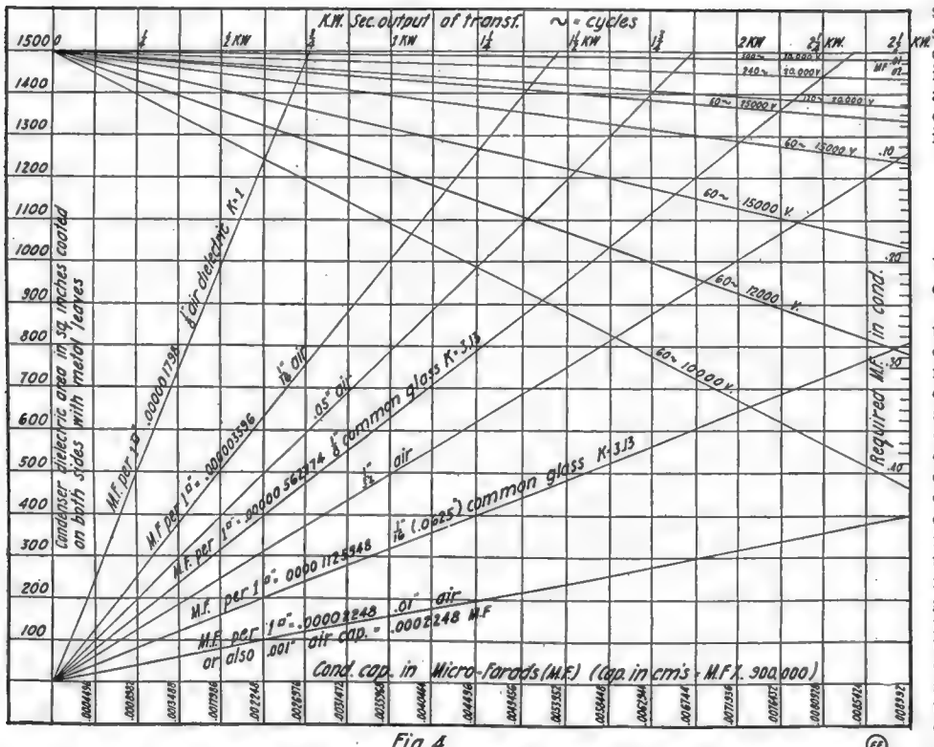
A few interesting points with respect to the physical action of electrical condensers will be mentioned briefly. A great many believe that, given a condenser composed of a glass plate coated on both sides with metal leaves, and when this is charged by connection to a static machine or other source of high tension current, the metal leaves of the condenser hold the charge. That such is not the case is readily proven by simply removing the two metal leaves from proximity to the glass plate and discharging these metal elements by connecting them to a grounded conductor. If, now, the metal plates are again placed in contact with the glass plate or dielectric and the condenser terminals are joined to a galvanoscope or electrometer, it will be found that a powerful discharge takes place, indicating that the electrical discharge resided, not on the metal plates, but in the dielectric.

Early investigators, among whom Faraday was a prominent one, assumed that when a condenser is charged, the whole phenomenon is not fully described by mere-

(*Continued on page 769*)



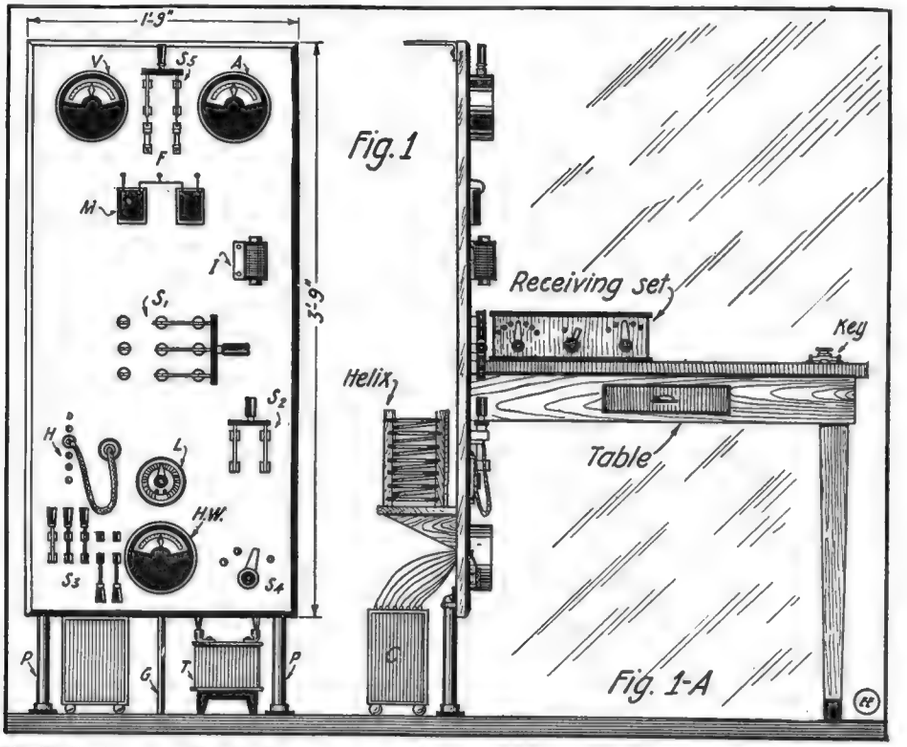
Hydraulic Analogy Demonstrating the Discharge of an Electric Condenser Thru an Oscillatory Circuit. In High Resistance Circuits (Small Pipe) the Discharge is Non-Oscillatory, or the Water Rises Slowly in the Opposite Chamber Without Oscillating.


K.W. Sec. output of transf.
~ = cycles
Condenser dielectric area in sq. inches coated on both sides with metal leaves
Cond. cap. in Micro-Farads (M.F.) (cap. in cm's ÷ M.F. 900,000)
Required M.F. in cond.
Fig 4

Direct Reading Curves Giving the Required Condenser Capacity for Various Radio Transformers, Also Capacities for Different Dielectrics of Various "Active" Areas. If Values at Bottom are Multiplied By 10, Then the Required Area (Left) in Square Inches Must Be Multiplied by 10 Also.

Up-to-date Radio Amateur Switchboard

A few years ago the visitor to the amateur wireless station expected to see a maze of wires, contacts, hard rubber knobs, binding posts, etc., and as a rule he was not in the least disappointed. The radio "bug" who could collect the most junk, who could put on display the largest assortment of "adjusting devices" and who could put the most curls in his connections was the most envied and the most admired by all his fellows. But no more of this. The trend of modern radio equipment is compactness, simplicity and last, but by no means least, *efficiency;* and in designing and building his station the amateur could well keep these three desirable qualities in mind.



The Radio Amateur Will Do Well to Study This Design of Station Switchboard. Modern Practise Tends Toward the Compact Arrangement of the Apparatus, Which, Among Other Things, Keeps the Connections Short and the Leakage and Other Losses Down to a Minimum.

If at all possible a separate room should be secured. It need not be large, just room enough to accommodate a fair-sized table and floor space for a small switchboard and transmitting apparatus. In the majority of cases a transformer is employed, and it is best to enclose it in a case to protect it from mechanical injury, making allowance, of course, for cooling. All connections to the secondary should be made of heavy rubber insulated, stranded copper wire. In case of a rotary spark gap, it is best to have only two electrodes rotating, thus lessening vibration and facilitating a quick start and stop. The condenser should be built of heavy glass plates and all corners of the tinfoil rounded off and edges painted with shellac or immerse it in transil oil. If carefully constructed it will stand considerable overload, for there are often times when we feel like making a "record." The key is placed not too far in from the edge of the table; only tests will determine the most comfortable position. The table for the instruments should be constructed of highly polished oak, about 2 feet 6 inches wide and 5 or 6 feet long. The key, in case it is not advisable to mar the table by screwing it down, may be mounted on a separate base and connected to the primary circuit by a flexible cord. The switchboard is constructed preferably of an insulator, such as Bakelite, but wood, well-seasoned and coated with dull black insulating varnish may be substituted.

Fig. 1 and Fig 1-A, show the front and side views of a switchboard designed by myself for a friend and which is here given merely as a suggestion. V and A are voltmeter and ammeter respectively and are not really necessary. S_5 is a switch for 110 volts with fuses F. M are two ½ MF condensers as required by the Underwriters. I is an impedance coil, S_1 is the standard form of aerial switch with primary cut-out. S_2 is the switch for rotary gap motor, the speed of which is controlled by rheostat L. H is the helix connections which are novel in that each turn of the helix, mounted on a bracket as shown in Fig. 1-A, is connected to a jack receptacle and a plug with flexible cord is used to connect in the desired turns. S_3 are small S. P. S. T. switches and are used to throw in as many sections of the large plate glass condenser C as may be needed. HW is, of course, a hot-wire ammeter placed in the ground circuit G and S_4 is a four-contact switch placed in the primary of the transformer T. P are supports made of 1-inch pipe and bolted to the floor.

Thus no part of the transmitting set is on the table except the key. The receiving instruments should be of the cabinet form and all movements "rotary" as far as possible. Hard rubber switch panels on the set add greatly, of course, to the appearance, but if a good hard wood is selected and properly varnished and finished, it will be a close rival. Frame the hook-up of your set so that you can instantly refer to it in case of need, also keep a diary in which to record all matters relating to receiving and sending messages from your station, also the strength of signals. Make it a daily rule to test all detectors and see that all contacts are clean, making any necessary adjustments in key or spark gaps, etc. A loud-speaking 'phone or an extra pair of receivers will be found convenient to satisfy the curiosity of visitors. In concluding I would say, do not litter your table or plaster your wall with "Danger" signs, but instead hang up neat engravings of men such as Marconi, Edison, etc., or pictures of interest to those dabbling in science. I know of one young man who made a small oak frame of a size to fit a large sheet of writing paper and every day posts in it news and weather reports as obtained from some of the big radio stations, such as Arlington.

Contributed by

H. C. GRAHAM.

A MULTI-MINERAL, DUPLEX POINT DETECTOR STAND.

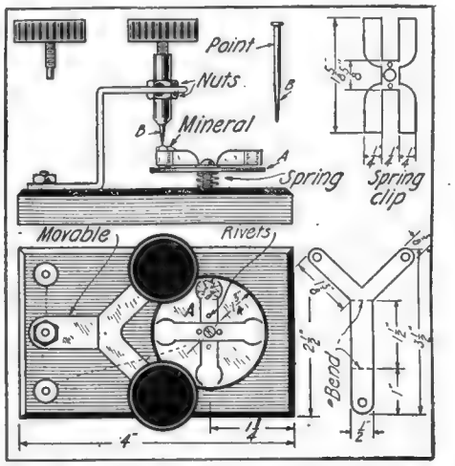
A mineral detector stand of unusual design is shown in the accompanying illustration.

The base may be made of wood, hard rubber, fiber, or marble as desired. The vertical bracket is made of ¼-inch brass. One contact screw has the ordinary cat-whisker spring attached. The other is of the plunger type; this may be fashioned from an old metal base valve, taken from a bicycle tire. Remove spring and tap for thread on screw. Make a few small points as shown, of different metal, suitable for the different minerals used. If a small lock washer is placed under the nut which fastens the bracket to the base, it will serve to hold it in position rigidly.

The disc A is made of copper or brass, 1¾ inches in diameter by 1/16 inch thick. Bronze, spring-clips are made and riveted to disc, as shown. The mineral may be held by these clips or you may take the brass caps off small fiber tube fuse plugs and run them full of Hugonium alloy or solder and set your mineral in this. The spring under this disc should be very stiff so that the disc may be held rigidly in any position.

The plunger barrel should be tapped only half way, the remainder to be drilled smooth and, the heads on points made to fit this bore snugly to prevent sticking. As the spring used in bicycle valves is not very strong this is necessary.

Contributed by BERT SPEICHER.



This Mineral Detector Allows a Rapid Change of Minerals and Contact Points to be Effected—A Very Desirable Quality in Any Detector.

TO REMOVE HARD GREASE, PAINT, ETC., FROM MACHINERY.

Add half a pound of caustic soda to two gallons of water and boil the parts to be cleaned in the fluid. It is possible to use it several times before exhausted.

Contributed by F. M. KIMBLE.

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A New Circuit for Undamped Wave Signal Reception*

By DR. GORDON M. CHRISTINE

AS an incentive to the members of my Boy Scout Troop to study wireless telegraphy, and because I myself developed an interest in it on account of its scientific character, I constructed an aerial and put in an outfit which has enabled me to copy signals within a large area.

I endeavored to hear the undamped wave signals of Sayville, Tuckerton and other similar stations, but soon found that the coils and other reception apparatus described for that purpose were complicated, expensive and uncertain. Tho I was anxious to receive from these stations, it was prohibitive unless I went into the installation of an outfit of a larger degree than I cared to fit up.

I learned that the operators trained for this purpose were of the expert type, most ordinary operators being discouraged by reason of the delicate, supersensitive nature of the large and numerous oscillating circuit coils required, and because, too, of the readiness of the apparatus to fail at inopportune times. This promised to make the study of the experimenting amateur along the lines of the reception of arc station signals an intricate and somewhat aristocratic one.

While making inquiry as to the simplest method for the reception of these arc station signals I was informed by Mr. F. B. Chambers of Philadelphia, regarding his very recent experiments in the use of his special circuit, consisting essentially of a large loose coupler with an added length of a foot or more of wire from the aerial side of the primary of the loose coupler coil to the wing of the Audion.

After a demonstration by Mr. Chambers, and amazed and imprest with his results, and wishing also to ascertain if the same could be obtained on my aerial of about 150 meters natural wave length, with a round Audion bulb of uncertain oscillating properties, Mr. Chambers at my request brought his coupler to my station and hooked it up. My "A" battery was unfortunately that evening reduced in emf. to about 2 volts, and some weak, used dry cell batteries had to be brought into play to serve as an "A" battery to oscillate the Audion bulb. Of course it will be understood that dry cells would not under these circumstances hold up as would a storage battery.

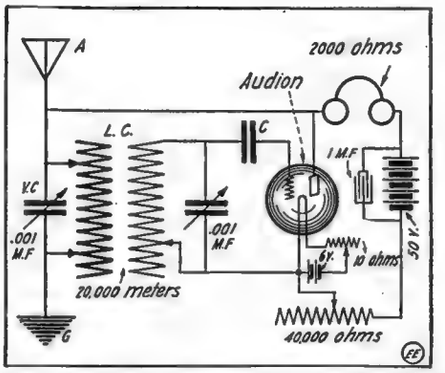
The experiment promised therefore from the beginning to be a failure and Mr. Chambers entertained no hope of success under the existing conditions.

The night was very rainy and disturbances were numerous; however, the bulb oscillated and I was enabled to read clearly and distinctly the signals of both Sayville and Tuckerton. Mr. Chambers then used his tubular bulb and found that my round bulb was almost as good as his long bulb!

With this success in mind, I tried out the *Chambers Coupler* directly, for the reception of undamped waves, and using his new circuit have had abundant success with it, reading the arc signals any kind of night and thru any kind of interference.

I recently had the pleasure of listening to the arc signals thru the *North amplifying phones* with marvelously increased loudness of signals.

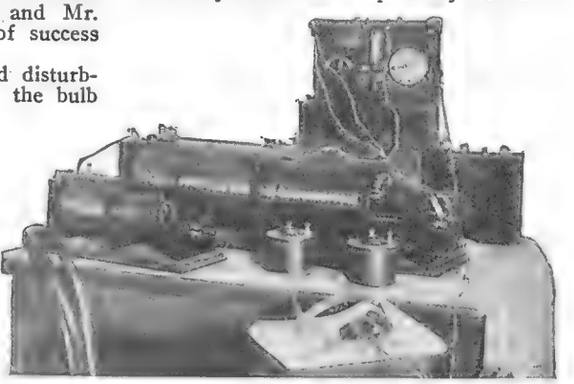
Readers of THE ELECTRICAL EXPERIMENTER will doubtless be greatly interested in this new circuit, which for cost, etc., is within the reach of the average amateur, and is undoubtedly about the last word on the subject.



The "Chambers" Undamped Wave Set Hook-Up, Utilizing an Oscillating Vacuum Detector and a Long Wave Loose Coupler, Not Wasteful Loading Coils.

With large oscillating coils, numerous long-handled variable condensers, intricate adjustment, long and tedious training of the expert operator, and an almost prohibitive expense for the average amateur, the difficulties in the way of satisfactory reception of the arc signals are now set aside, and we have in the very simple, easily understood, and readily operated circuit here described, a really wonderful development in Wireless Telegraphy.

The music-box effect produced by switch movements along the multiple selective points of the secondary of the loose coupler is decidedly interesting. I have suggested to Mr. Chambers simply as a matter of interest and experiment, the attachment of wires from these points, made more numerous if necessary, to an improvised key-board which probably could be made to produce music thru an entire octave or two of the musical scale.



View of New "Chambers" Undamped Wave Receiving Set Here Described in Detail and Which Makes Possible the Reception of Long Distance Stations With Very Simple Tuning.

To those who know of the difficulties in the way of bringing to the ear in readable form the signals of arc stations, say of Sayville, Tuckerton and Nauen, this new circuit will furnish a strong appeal for recognition.

I am pleased to have been the means of having Mr. Chambers first demonstrate the efficacy of his new circuit on a comparatively small amateur antenna.

Indeed, it would appear that aerials of very great capacity are not so serviceable as are aerials of average wave length.

Summing up—it is to be said that with an aerial fifty feet above ground, 5 wires *50 feet long each*, and 2 feet apart, with a lead-in of 20 feet, with the *Chambers Circuit*, and with an ordinary Audion detector having a round bulb, I hear with more than readable distinctness the arc signals of Sayville and Tuckerton.

Those wishing to try out this new scheme should note the following:

First: One should provide two rotary variable condensers, one to use across primary, and one across secondary of coupler, so that with aerial and condensers, it brings coupler down to minimum size; otherwise, without the two variables, it would be necessary to build an exceedingly large coupler, to reach 20,000 meters.

Second: A coupler of the size shown in the photograph, can be built as follows: primary tube, 7″ diameter, 14″ long; wound full of No. 24 enameled wire; secondary tube, 6″ diameter, 13½″ long, and wound full of No. 30 enameled wire. The secondary should have 10 taps, evenly spaced, but the author recommends sliding contacts on primary, as there is no capacity loss when sliders are used, and it renders the tuning for undamped waves much easier.

The use of enameled wire makes the coupler most efficient, as it does not absorb moisture like fabric-covered wires, al-

(*Continued on page 751*)

* *Paper read before The Wireless Association of Pennsylvania, July 14th, 1916. (Revised.)*

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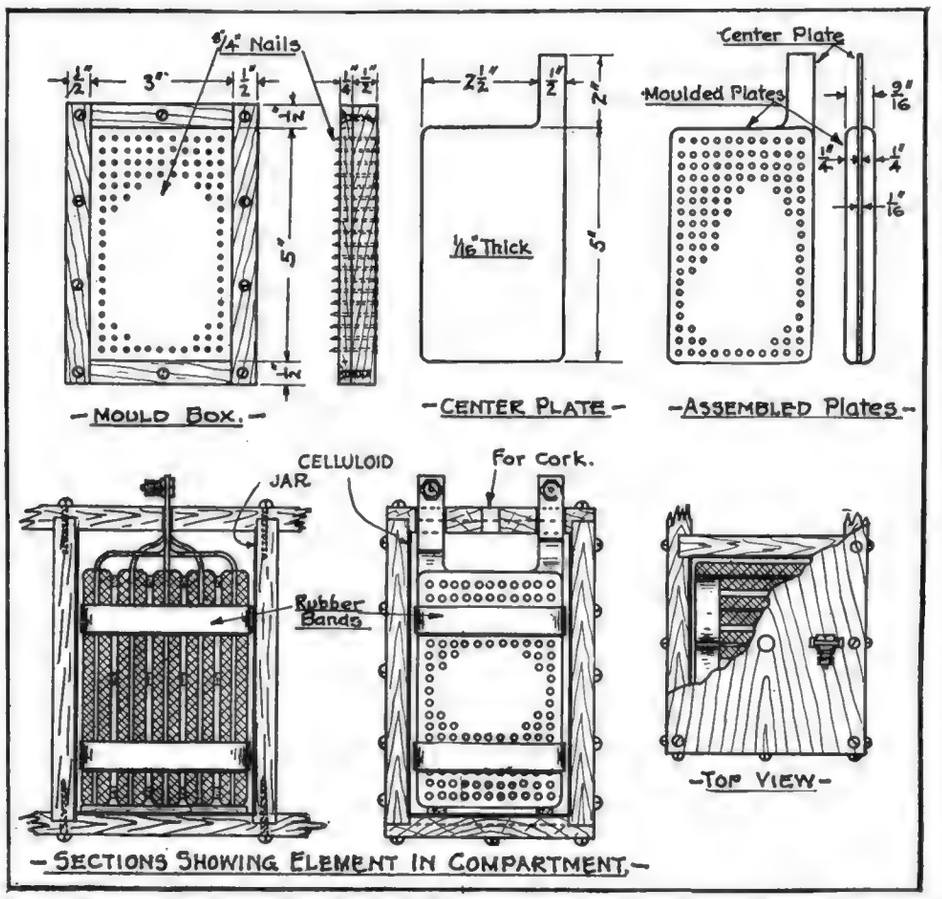
THE CONSTRUCTOR

Construction of a 6-Volt, 25 A.H. Storage Battery

By B. Francis Dashiell

THE storage battery described in this article is of the acid-lead type and has an output of 25 ampere-hours at 6 volts. It consists of three cells assembled in one box or container, each cell having a capacity of 25 ampere-hours and 2 volts; the connections being series between cells.

To make the box, use only selected white pine, ½" thick. Cut out two similar pieces for the top and bottom as shown in the accompanying drawings. They are each 4¼" wide and 13¼" long. Rabbet the edges ¼" deep and ½" wide and cut two cross slots or notches ¼" deep and ½" wide to accommodate the two division pieces, between the cells. The one piece to be used for the top or cover should have the holes cut in the three cell panels as shown. A round hole is bored in each panel to pour the electrolyte thru, into the cell. The two rectangular slots are cut for the battery connecting lugs to come up thru. Next cut out the two side pieces; they are 6" high and 12¾" long and are grooved the same as the two above pieces to accommodate the two division boards. These division boards are 6" high and 3¾" wide. The two end pieces are 6" high and 4¼" wide and are rabbeted along the 6" sides, ¼" deep and ½" wide and are clearly indicated in the detailed drawings of the parts of the case.



Working Drawings for Constructing a 6-Volt, 25 Ampere-Hour, Lead Type Storage Battery. Excellent for Gasoline Engine Ignition Systems, Radio Sets and All Laboratory Requirements.

The assembling of the frames for the box or case is done with a good grade of cabinetmakers' glue and brass screws. Fit the bottom and two sides carefully together with the glue and then place screws at the proper places about 1¼" apart. Put some glue on the edges of the division boards and slide down in their respective grooves and screw from the sides and bottom. Place the ends on and screw up as required; all the joints must be drawn tight so that the glue squeezes out. When the box has thoroly dried it is cleaned and painted with several coats of thin shellac inside and out. We now have to construct the celluloid acid-proof containers as described elsewhere in this issue. These have 1/16" walls only and fit readily into the wooden case.

The different elements of the battery should now be constructed; the lead used must be absolutely pure. Each plate, as assembled and shown in the drawings, is made up of two cast lead plates with a cut sheet of lead between, and the three parts then soldered around the edges. The plates are cast in a mould box from pure lead. The box is made from a piece of oak 4" by 6" and 1" thick. It has oak strips ¼" thick and ½" wide fastened around the top edge so as to enclose a space 3" by 5" and ¼" deep. Drive a number of thick wire nails up through the bottom so as to fill this space entirely with the points and on about 3/16" centers. The plates are made by pouring the molten lead into the mould box, and as this small quantity of metal will *set* almost immediately, the casting can be turned out to cool and thus prevent the box becoming charred. In this manner the entire lot of 30 plates can be cast without charring the box to such an extent as to impair its usefulness. Thirty of the cast plates will be required and they should be smoothed up neatly after casting, with a rough file.

Cut from pure sheet lead not over 1/16" thick, 15 cut plates or *centers*, 3" by 5" and with a ½" by 2" lug projecting from one corner, as shown in the drawing of this plate. Assemble the plates by placing a cast plate on either side of the cut *center* plate and solder all parts together around the edges with pure lead solder. This gives 15 complete plates, 5 being used to each of the three cells.

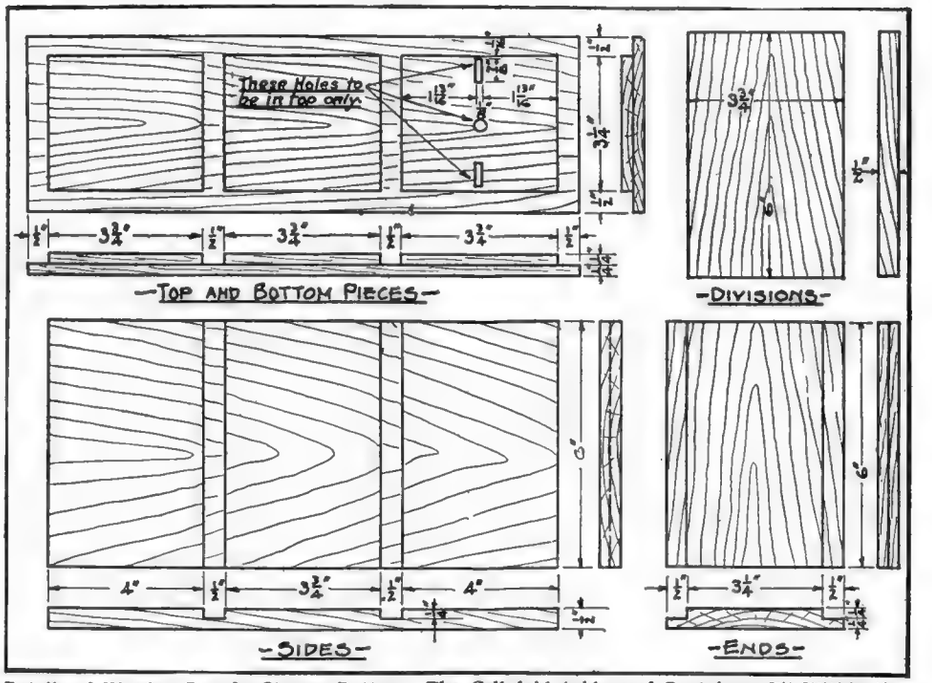
Two separate pastes are now made up as follows in glass or earthenware vessels. Make one from powdered red lead and dilute sulfuric acid and the other from yellow lead or litharge and acid. Mix the pastes up thickly (*the paste must never be thin*) and fill the holes in the plates with it. Fill nine of the plates with the yellow paste and the holes (made by the nails in the mould box) in the other six plates with the red paste. The red plates are known as the positive plates and the nine yellow plates are the negatives. Make sure the holes are prest full of paste and set away to dry well in the open air.

Each cell element is now ready to be assembled. Lay down a negative plate with the top connecting lug to the left, and the bottom facing the operator. Now lay three strips of hard rubber 1/16" thick and ⅛" wide across the plate, one at the top, one in the center and the other across the lower part. These serve to keep the plates separated. Lay a positive plate on this with its lug to the right, then three more separating strips and another negative plate, and so on. Three negatives and two positives, a negative being on each side of the pile and one at the center. Place two heavy rubber bands around the pile of plates to hold them firmly together. Bring

the connecting lugs of the negative plates together and solder; do the same with the lugs of the positive plates. The center lug of each set of similar plates should extend upward as indicated in the accompanying drawings of the plates. Place several strips of shellacked wood in the bottom of each cell of the container box. Place the three complete battery elements in the three cells, leaving the rubber bands in place. Put the top in place, with the connecting lugs projecting upwards thru their respective slots in the top and screw the top in position. Connect the lugs in series between cells; that is, the negative lug of one cell to the positive lug of the adjoining cell, use lead strips for connections and lead solder at the joints. This will leave two free lugs at either end of the battery, a positive and a negative. These should be provided with suitable binding posts for making connections with the battery.

Mix up in a glass or earthenware vessel, a solution consisting of one part of pure sulfuric acid and 5 parts of distilled water, pouring the acid into the water slowly and stirring meanwhile. Pour the mixture into the three cells thru the center holes until the tops of the plates are covered. Place corks in the holes as the necessary ventilation will be secured around the lugs.

Charge the battery the first time by connecting the two terminals to similar poles of a source of direct current of 8 volts at 6 amperes. Charge steadily for five hours, after which discharge slowly thru a motor or light until completely run down. Recharge and discharge again and repeat the process for four times. Now reduce the charging current to seven volts and four amperes and charge slowly for about seven hours or until each cell of the battery will read from 2.5 to 2.7 volts on a small voltmeter. When each cell tests this high the battery has reached its maximum charge and further charging is unnecessary. Keep the battery charged and do not allow the voltage to drop below 1.8 per cell, but recharge at once. It will be found that the battery will improve with use as the plates reach the complete chemical formation.



Details of Wooden Case for Storage Battery. The Celluloid Acid-proof Containers Fit Within the Compartments Here Shown.

STANDARD TIME IN VARIOUS COUNTRIES.

An hourly zone system of standard time has been adopted in many countries as follows:

GREENWICH MEAN TIME (western Europe time)—Algeria, Belgium, Faroe Islands, France, Gibraltar, Great Britain, Portugal, Spain.

One hour *fast* of G.M.T. (central Europe time) Austria-Hungary, Angola, Congo, Denmark, German South West Africa, Germany, Italy, Malta, Norway, Servia, Sweden, Switzerland, Tunis.

Two hours fast (eastern Europe time) Bulgaria, Cyprus, Egypt, Portugese East Africa, Roumania, South Africa.

Four hours fast: Mauritus, Reunion, Seychelles.

Five hours fast: Chagos Islands, Portugese, India.

Five and a-half hours fast: Ceylon, India (except Calcutta).

Six hours fast: Calcutta.

Six and a-half hours fast: Burmah.

Seven hours fast: Federated Malay States, French Indo-China, Straits Settlements.

Eight hours fast: British North Borneo, East Coast of China, Hong Kong, Kiau Chau, Labuan, Philippine Islands, Shanghai, Western Australia.

Eight and a-half hours fast: Korea.

Nine hours fast: Chemulpo, Japan, Seoul.

Nine and a-half hours fast: Guam and South Australia.

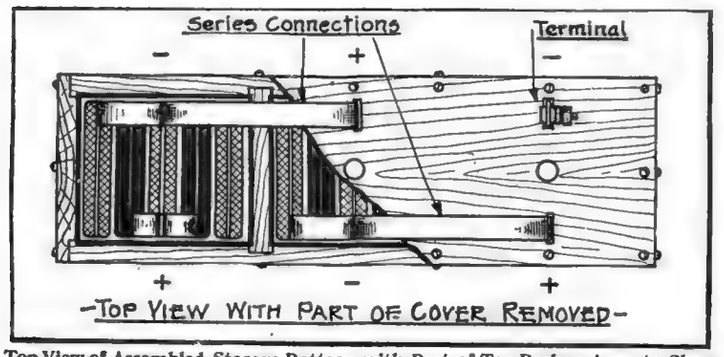
Ten hours fast: Caroline Islands, New Guinea, New South Wales, Queensland, Tasmania, Victoria.

Eleven and a-half hours fast: New Zealand.

Eleven and a-half hours *slow:* Samoa.

Ten and a-half hours slow: Hawaii (or Sandwich) Islands.

Nine hours slow: Alaska.



Top View of Assembled Storage Battery, with Part of Top Broken Away to Show Plates and Connections.

Eight hours slow (Pacific time): From 112½° W. to the West coast of the U. S. and Canada.

Seven hours slow (Mountain time): Between 97½° and 112½° W. in U. S. A. and Canada.

Six hours slow (Central time): Between 82½° and 97½° W. in U. S. and Canada, and Honduras.

Five hours slow (Eastern time): Between 67½° and 82½° W. in U. S., Canada, Chili, Panama and Peru.

Four and a-half hours slow: Venezuela.

Four hours slow (Atlantic or Inter-Colonial time): From the East Coast to 67½° W. of U.S.A. and Canada, and Nova Scotia, Prince Edward Island, British and French Guiana, Grenada, Martinique, Miquelon, New Brunswick, Porto Rico, Tobago, Trinidad.

Two hours slow: Azores and Cape Verde Islands.

One hour slow: Iceland, Liberia, Maderia, Portugese Guinea.

OTHER STANDARD TIMES.

Holland: 19 min. 32-1 sec. *fast* of G. M.T.; Greece, 1 hour 34 min. 59-9 sec. fast of G. M.T.; Russia, 2 hours 1 min. 18-6 sec. fast of G.M.T.; Java, 7 hours 19 min. 14-5 sec. fast of G.M.T.; Ireland, 25 min. 21-1 sec. *slow* of G.M.T.; Ascension, 57 min. 36 sec. slow of G.M.T.; Brazil, 2 hours 52 min. 41-4 sec. slow of G.M.T.; Uruguay, 3 hours 44 min. 48-9 sec. slow of G.M.T.; Argentine Republic, 4 hours 16 min. 48-2 sec. slow of G.M.T.; Colombia, 4 hours 56 min. 52-4 sec. slow of G.M.T.; Equador, 5 hours 14 min. 06-7 sec. slow of G.M.T.; Cuba, 5 hours 29 min. 23-7 sec. slow of G.M.T.; Costa Rica, 5 hours 36 min. 16-9 sec. slow of G.M.T.; Nicaragua, 5 hours 45 min. 10 sec. slow of G.M.T.; Salvador, 5 hours 56 min. 32 sec. slow of G.M.T.; Mexico, 6 hours 36 min. 26-7 sec. slow of G.M.T.

TIME SIGNALS.

France: Eiffel Tower, 10 a.m. and midnight, G.M.T.; λ =2,500 m. Germany: Norddeich, 12 noon and midnight, G.M.T.; λ=1,650 m. Japan: Chosti, 8:59 to 9:04 p.m., Japanese time, weekdays; =600 m. Mexico: Camperte, 12 noon, local time; λ=600 m. South Africa: Cape Town, 11 p.m., standard time; λ=600 m.

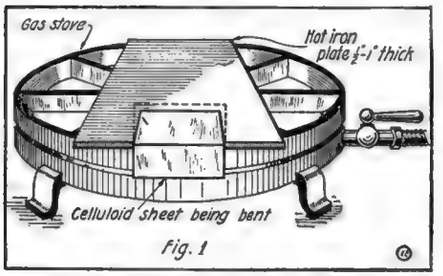
United States of America, Atlantic Coast: Arlington (high power), 12 noon and 10 p.m., Eastern time; λ=2,500 m. Key West, 12 noon, Eastern time, λ=1,000 m. New Orleans, 12 noon, Eastern time, λ=1,000 m. Failing Arlington high-power set, the low-power set emits the signals, and also Boston, Newport, Norfolk and Charleston.

Pacific Coast: Mare Island, 12 noon and 10 p.m., Pacific Time; λ=2,500m. Eureka 12 noon week days, Pacific Time λ=1,400 m. San Diego, 12 noon week days, Pacific Time, λ=2,000 m. North Head, 12 noon week days, Pacific Time; λ=2,000 m.

Making Celluloid Battery Jars

VERY often the experimenter requires certain types of jars or vessels in carrying out important experiments and not infrequently these experiments are abandoned for lack of the container.

Storage batteries particularly require



Method of Gently and Evenly Heating the Celluloid Sheet Before Bending by Means of Gas Stove and Thick Iron Plate

square or oblong jars and such jars are not easily procurable in the open market. Very few supply houses carry them in stock and the glass manufacturers as a rule do not sell small quantities. The same holds true of hard rubber jars to a large extent. And when it comes to particularly odd sizes or shapes, the experimenter as a rule is up "against a stone wall."

Somehow, the fact that celluloid battery jars are more than desirable in one way, does not seem to be known to the experimenter at large. Nevertheless, celluloid jars are distinctly superior to glass or hard rubber. They are light and are not affected by even severe jars, as are glass and hard rubber. Celluloid jars are not affected by storage battery electrolytes or ordinary salt solutions. Such jars are transparent, take up little room, and best of all, they can be manufactured by almost anyone. The cost is not prohibitive and almost any size can be made.

The Editor of this journal who has had considerable experience in manufacturing automobile and motorcycle, as well as small pocket storage batteries, herewith desires to give his experience to the readers of THE ELECTRICAL EXPERIMENTER. The processes as described in this article are regarded as trade secrets and the writer doubts if they have ever appeared in print before.

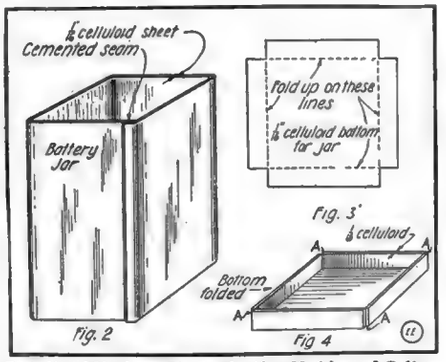
The first step to take is the securing of the necessary celluloid sheeting. Only three companies in this country make it and there are only a few concerns jobbing the celluloid.* The right material to use is what is known as either "Amber" or "Colorless" transparent celluloid sheeting. As to the thickness no exact advice can be given as this depends upon the size of the vessel to be made. Naturally a large jar containing a quantity of heavy plates must have thicker walls than a small jar. As a rule small jars not larger than 3"x3"x5" require celluloid about 1/32" thick. Larger jars require walls of about 3/64" and heavier. Figure out how many square feet you require and then order about 10 to 15 per cent above your requirements.

While you are waiting for the sheeting it is necessary to build the *Hot Plate.* This consists of a gas or electric stove topt with a heavy steel or iron plate at least ¼" or better ½" to 1" thick. See Fig. 1. The most important part is that the heat must be regulated. With a gas stove this is simple as the cock can be opened more or less. With an electric stove we will need a good rheostat. Now heat up the hot plate in such a manner that a small test piece, cut from the celluloid sheeting, will remain on the hot plate for at least ten seconds without bursting into a flame. Then, when taken off the plate, it must be as soft and pliable as a thin piece of fresh dough. Should the testpiece or celluloid blister badly, the plate is too hot. In that case reduce the heat.

CAUTION: Always remember that celluloid is extremely inflammable. KEEP AWAY FROM AN OPEN FLAME. For this reason the square hot plate, at the end where you work, should overlap the stove for at least two inches.

With a small piece of sheeting, say 3"x3", begin practising to gain experience in bending and shaping the material. Fig. 1 shows how a square bend is made. As soon as the sheeting is soft, quickly bend to the required shape and pull it off at once from the hot plate. If a right angle is desired place the hot sheeting over a square block of wood. In thirty seconds the shaped piece has cooled and is stiff. Bends can of course be made downward or upward as indicated by dotted lines in Fig. 1. The important part is that the corners, after cooling, must not show cracks or fissures. If they do, you attempted to bend before the celluloid was sufficiently heated. Fig. 2 shows the main body of a battery jar, bent four times. Fig. 3 shows the bottom (or top) before bending while Fig. 4 shows the same part after bending.

Before attempting to bend the sheeting take a sharp-pointed tool and scratch lines



Details of Various Stages in the Making of Celluloid Battery Jars

on the sheeting at the points where the bend is to come. These lines can be easily watched while bending and the resulting jar will be more perfect than when no guiding lines are used.

There is still another method of bending celluloid. This is the *hot water* method. Thus a piece of sheeting when plunged in ALMOST boiling water for a few seconds, will come out soft and pliable. It can then be formed over wooden blocks to the required shape. This method is not considered a good one by the writer as it tends to warp the entire jar.

Cementing.

Alcohol, Amyl Acetat and Acetone are good solvents for celluloid. From these the necessary cements are made.

The writer prefers the use of Acetone, which is fairly cheap and can be had at most drug stores. Procure half a pint in a wide-mouthed bottle and remember that acetone is inflammable and when strongly inhaled causes coughing and dizziness. Otherwise it is not dangerous. When commercially pure it should be colorless as water.

Cut up *very thin* strips of celluloid and drop them into the bottle containing the acetone. Into the one-half pint bottle throw about two ounces of the celluloid strips. Before putting the bottle away shake it for some minutes. You will observe that the celluloid begins to dissolve slowly. In from 24 to 48 hours all the celluloid has been *digested* and the cement is ready. During this time it is necessary to frequently shake the bottle, otherwise, the imperfectly digested celluloid will stick to the bottom of the bottle in a thick, sticky mass.

When ready the cement should have the consistency of mucilage. If too thin add more celluloid, if too thick add acetone.

Now take the part shown in Fig. 2 and apply the cement with a small brush to both surfaces which are to be in contact permanently. Do not spare the cement, use plenty and put it on thick. After applying put the seam face down and apply weights on the inside of the jar, so that the seam-part is under pressure over its entire length. Leave in this position for *at least six hours* and better twenty-four hours. After that you have a water- and acid-proof seam. Remember celluloid cement does not stick in the manner of paste or mucilage. It actually *dissolves* the celluloid surfaces to a certain depth and after drying the seam is as solid and homogeneous as the entire jar.

The bottomless jar now receives its bottom, Fig. 4, but before doing so, all the contacting surfaces of both jar and bottom must be heavily coated with cement. Be sure that there is plenty of cement in the four corners, otherwise, there will be leaks. Place weights on top of the jar and leave in this position for *at least six hours.* Heavy rubber bands should be put around the bottom part, to insure good contact with the jar. The latter is quite important. After the cement has set, apply a new lot in the inside corners as well as where the jar edges touch the bottom. The outside corners should also be cemented again and for a good job, small celluloid pieces should be cemented in the open corners, shown at "A," Fig. 4. The jar is now completed and is then put in a DRY room for at least twelve hours.

After that, test by filling it with water to the top. Compress at two opposite corners, which forces the jar slightly out of shape. If no leak develops the jar is water and acid-proof.

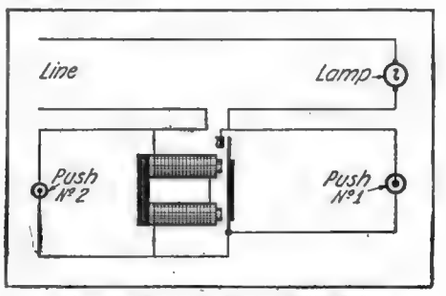
For a precautionary measure the jar may be filled with electrolyte over night and by placing it on a piece of blotting paper, even the smallest leak will be detected.

Should a leak develop, do not attempt to cement *until the jar is absolutely dry.* Even a slightly moist surface prevents the cement from taking hold.

By addressing a stamped envelope to our Technical Information Bureau, the names of the various concerns will be supplied.

A HANDY USE FOR A RELAY.

Referring to the diagram push button No. 1 will light the lamp; No. 2 will extinguish it.



Remote Control of Lamp with Relay

The relay must be so adjusted that the *uninsulated* contact is on the side of the magnets; otherwise it will not work.

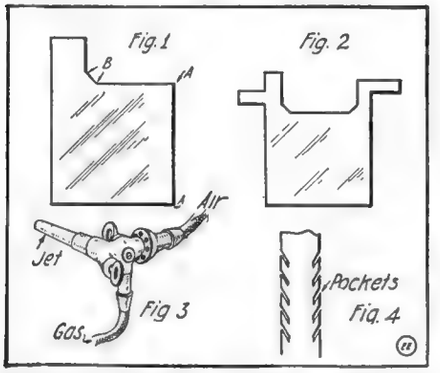
Contributed by HENRY ABRAHAM.

CASTING STORAGE BATTERY PLATES.

I have seen several articles on making storage battery plates (providing sheet-lead of suitable thickness is at hand), but this method, I think, is original inasmuch as any scrap lead can be converted into excellent plates. The idea is to melt the lead in a pan of the right shape, which can be made as follows:

On a piece of thin sheet-iron draw an outline of the plate required, making all the corners square. Outside this outline draw another line ¼ inch from the first, and with a pair of shears cut to the outside line. At each of the corners a slit must be made, and the ¼ inch edge turned up all around. At such corners as A, Fig. 1, the iron from the slit is bent so as to close any openings, to prevent the molten lead from running out. At B this cannot be done, but the opening can be closed in another way as will be seen below.

The pan should be stiffened by riveting two or three pieces of iron 1 inch wide by ⅛ inch thick to the bottom, crosswise, flattening the rivet heads. One of these pieces should be so placed that its edge will be left projecting at B. The opening is then filled in with plaster-of-paris, which should be dry before the pan is used. Any bright spots must be painted or prepared in some way so the lead will not stick.



Method of Preparing a Sheet-Iron Mold and Blow-Pipe Gas Flame for Molding Storage Battery Plates.

Now for the casting. Place the pan on a gas stove (with the flame touching as much of the mold as possible but not necessarily under the lug) and melt the lead in it to a depth of about 3/16 inch. This is the usual thickness, and can be tested with toothpicks pushed in each corner, by comparing the burnt marks. If one side or corner is too thick use small pieces of ⅛ inch iron to lift up that part to level the mold. When the right position has been determined, turn off the gas even though the lug has not been properly filled and immediately apply directly on the lead at this part a blow-torch flame, which will quickly melt it and allow it to spread out uniformly. After this has been done, let the mass cool. Upon hardening, you have a battery plate that will equal any plate cut from sheet lead.

If no blow-torch is at hand a makeshift can be improvised from a gas jet with the tip connected by a piece of tubing to the gas outlet pipe. When flame is blown on, it is hot and blue. Better still, use a double gas cock and two tubes; one for gas, the other for air. This is shown in Fig. 3.

The plate is now ready to be drilled as other articles show, but my method is to hammer out slanting "pockets" in the plate by means of a cold chisel, the wider the better, making several rows on each side of the plate. The sectional view of this is diagrammatically expressed in Fig. 4. The active material is then filled in the "pockets" in the usual manner.

I have made plates as shown in Figs. 1 and 2. Fig. 1 is 7 inches square, 9¾ inches to top of lug. Fig. 2 is 5¾ inches square, 8½ inches to top of highest lug. I have also tried to "cast" the holes in the plate, but this did not prove successful.

Contributed by LEWIS SCRIVEN.

WHICH POLE IS WHICH?

Students of electricity, when first they become acquainted with the subject, often find difficulty in remembering the polarity of the two poles of a battery or electrodes of an electroplating vat.

First as regards the battery. Instead of trying to remember the polarity of both zinc and copper, concentrate the attention on one only. If you can remember that *copper* is *positive* you will know that the other element, zinc, must necessarily be negative. Bear in mind that:—

Carbon and Copper, both beginning with C, have the same polarity. Copper is positive and so is Platinum.

If the zinc and copper cylinders in a Daniell cell are connected, by means of conducting wires, to two plates of platinum (or the ends of the wires themselves will do to illustrate the principle), and these are immersed in a chemical solution made by dissolving a metallic salt in water, they form what are called electrodes.

The positive electrode is connected with the copper or positive pole of the battery and of course the negative electrode is in communication with the negative pole.

The effect of passing an electric current is to split up the salt into its metallic and acid constituents, and these make their appearance at opposite electrodes. The positive electrode is called the *anode* and it is here that acids appear. (Remember Anode, Acids, both begin with A.) Oxygen, chlorin, and other non-metallic bodies, which play the part of acids, will be found at the anode. Having fixed this point it is not difficult to remember that the metal (the other constituents of a salt) appears at the negative electrode, which is termed the cathode.

To connect the words *negative* and *cathode* in the memory, try this:—

Using a solution of sulfate of copper (a compound of copper and sulfuric acid) and passing a current of electricity thru an electroplating vat, the Copper is deposited on the Cathode; the acid forms around the anode.

Finally, bear in mind that all electro-positive elements appear at the negative electrode (the opposite); while electro-negative elements go to the positive electrode.

Contributed by H. J. GRAY.

CLEANING COMMUTATORS.

Experience has taught that properly cleaned commutators are of vital importance in the maintenance of direct current machines especially. I find that by using parowax paraffin and piece of felt, fifty per cent of the needless cleaning up of brushes and holders can be avoided.

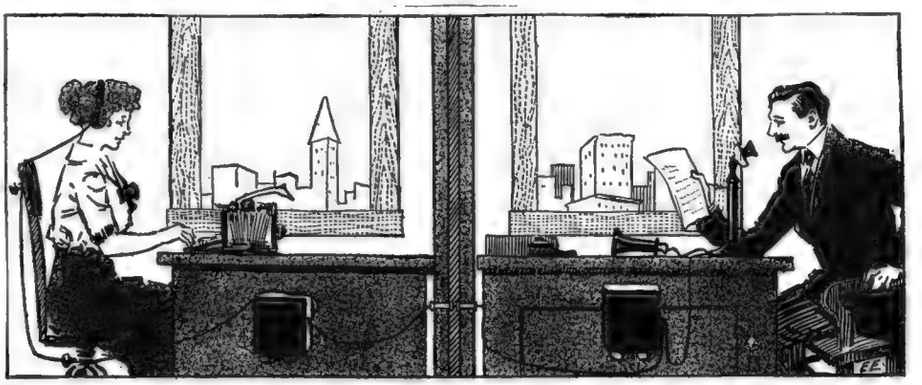
Instead of sand-papering a commutator every time it shows any roughness, a careful application of paraffin on one side of a set of brushes and at the same time rubbing back and forth with a piece of flannel or felt on the opposite side will cleanse it to perfection.

In using the wax this way, excessive oil is prevented from being absorbed by the other brushes, thereby keeping them from sticking and causing too heavy lubrication.

Contributed by RAY J. BUTTON.

USING THE TELEPHONE FOR STENOGRAPHIC DICTATION.

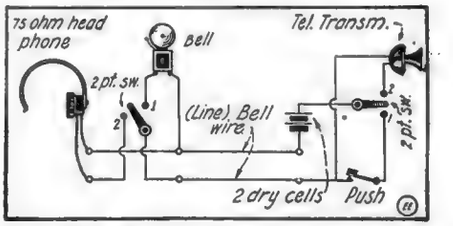
A scheme worked out some time ago and used very practically in the offices of one of the largest electrical companies in New York City, is described herewith, and



An Adaptation of the Telephone which Anyone Can Install for the Purpose of Dictating Correspondence

in many ways it possesses extreme merits which warrants its installation. In the majority of cases nowadays the stenographic staff is located in a different part of the building from that of the general office and the heads of departments. The illustration indicates a telephonic method of dictating to a stenographer, and in some cases this is very easily followed out where there are telephones already installed. The stenographer's desk should be fitted out with head-band and watch case receivers, so that the stenographer's hands will be left free to operate the typewriter.

A diagram is appended showing the calling and talking circuits for such a system, which are quite simple and readily understood. This layout can be purchased and installed for a few dollars and would comprise a 75 ohm pony receiver with head band, a two-point switch for the stenographer's desk, an ordinary vibrating call bell, necessary annunciator or bell wire, a couple of dry cells, two-point switch and also push button for the transmitting end of the line, and lastly an ordinary telephone transmitter or microphone. About four or five dollars will cover the cost of this set and most anyone can install same. It will save a great deal of time, especially where the stenographer is located some distance from the dictator's office.



Circuits of Telephone System Designed for Stenographic Dictation Between Two Offices.

HOW TO MAKE IT

This department will award the following monthly prizes: **First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.**
The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of **$3.00** is awarded; for the second best idea a **$2.00** prize, and for the third best a prize of **$1.00.** The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

SECOND PRIZE, $2.00

A "BOTTLE" HIGH FREQUENCY TESLA COIL.

The high frequency coil shown in the photograph was made by winding an old

Tesla Coil Made from Bottle and Capable of Giving a 3-inch Spark.

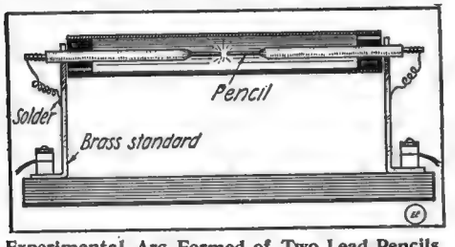
bottle, near the bottom, with a primary of six layers of No. 12 rubber covered wire. The secondary winding consists of a layer of No. 20 D.C.C. wire carried to the top. The knob on top is made from an old bell tapper inserted in the cork. The coil shown is capable of delivering a three inch spark when properly connected.

Contributed by A. E. GLAZIER.

SIMPLE EXPERIMENTAL ARC.

This quickly made arc consists of a glass tube, fitted at both ends with cork plugs, or stoppers, thru which pass two ordinary writing pencils cut so as to have their grafite rods protruding at both extremities. The battery wires are connected as shown in Fig. 1.

Such an arc answers very well for experimental purposes and gives excellent



Experimental Arc Formed of Two Lead Pencils in Glass Tube.

results when connected to about 18 volts.

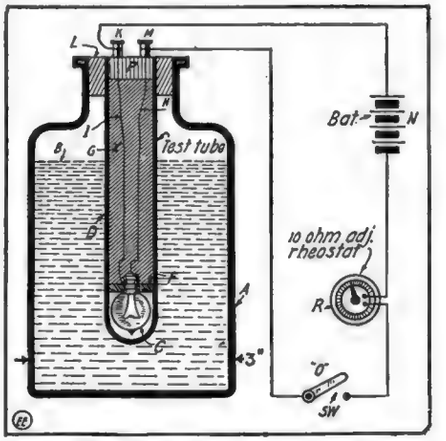
Contributed by JOHN T. DWYER.

FIRST PRIZE, $3.00

A BICHROMATE DARK-ROOM LAMP FOR PHOTOGRAPHERS.

The principal advantage of the bichromate dark-room photo developing lamp over other types, is that it gives a much brighter and stronger light, thus enabling the photographer to work in greater comfort without endangering his undeveloped plates. The following is a description of a lamp of this type which can be easily made and will be found to be very successful.

A glass bottle A, is filled with a solution of bichromate of potash. (A good red solution can be made also by dissolving a 5-grain permaganate of potash tablet in about 25 ozs. of warm water. The degree of color can be controlled by removing the tablet before it is entirely disintegrated, or for particularly dark reds more than one tablet may be used. They cost about ten cents a dozen.) Immersed in the solution is a small electric lamp C, supported by a test tube D. The lamp is connected by two wires H and I to two binding posts K and M, and these are connected in series with a battery consisting of two dry or other cells N and a switch O. The light produced by the lamp C is forced to pass thru the bichromate of potash solution and this permits only certain red rays to pass, thus producing a safe light for photographic work. To construct this lamp first procure



Dark-room Lamp Made from Battery Lamp, Test Tube and Red Solution.

a wide-mouthed bottle of about 3" diameter by 5" high, and a cork-stopper L to fit this bottle. For the lamp C, choose a miniature screw base metal filament lamp of about 3 volts and 1.5 to 2 candle-power. D is a test tube ¾" dia. by 3" length. The figure shows the method of mounting the lamp bulb in the glass test tube. F. is a cork stopper which fits D tightly and has a hole bored thru it to suit the base of lamp C. Twist the bulb thru the hole in F and solder a short copper wire, about 6" long, to each contact of the lamp, i.e., to the side and the bottom. A similar stopper P, is required, which must also fit snugly into D and this stopper carries two binding posts K and M. Solder the ends of the two wires H and I to K and M; drill a small hole thru P and fill the glass tube D with molten paraffin wax poured thru this hole, when the lamp itself is completed.

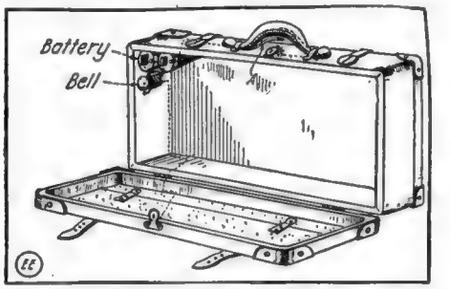
Two small dry cells N, form the battery and supply the current to the lamp. Connect the two cells in series; i.e., connect the zinc of one cell to the carbon electrode of the other cell and the battery will give about 3 volts. Procure a small switch O, and preferably an adjustable 10-ohm rheostat R, and connect the parts as shown in the diagram.

Contributed by C. A. OLDROYD.

THIRD PRIZE, $1.00

A "SAFETY FIRST" SUITCASE ALARM.

The accompanying illustration shows a novel "safety first" suitcase alarm. It contains a battery at the corner which can be secured by two strips of leather about one-half inch wide and some rivets. The bell or buzzer can be secured to the case in the same way. The brass strip A may be shaped to fit under the handle, but it must not normally fit against the handle because the other terminal from the battery goes



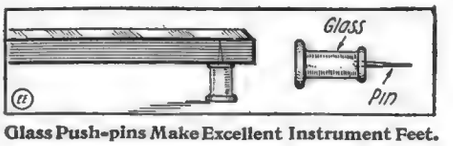
If the Wrong Person Picks Up This Suitcase the Alarm Rings.

to a contact in between the two. When you wish to leave the suitcase anywhere you close the switch and as soon as it is picked up the bell will ring, but otherwise the switch is left open. (The switch may be an extra hasp fastened on the suitcase.)

Contributed by Y. MATSUMOTO.

HOW TO OBTAIN GLASS FEET FOR INSTRUMENTS.

Many experimenters wish to insulate the base of a delicate instrument, but find that it does not look very attractive with porcelain insulators. If "Moore" push-pins (glass) are put in the corners, then the



Glass Push-pins Make Excellent Instrument Feet.

instrument will be efficiently insulated and also made very attractive. They can be purchased at any photo supply shop or stationery store.

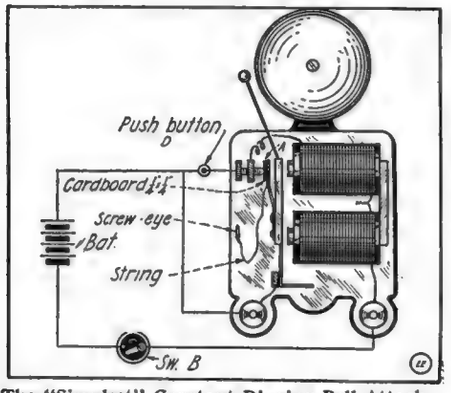
Contributed by SYDNEY MAUNDER.

A SIMPLE "CONSTANT RINGING" BELL.

For those interested in a cheap yet efficient, constant ringing electric bell, I present herewith a sketch of one, containing no parts except the bell itself.

A piece of thin card-board about ¼" square is inserted between the armature spring (A) and the adjusting post so as to break the circuit of the bell. The wiring is clearly shown in the accompanying sketch.

A handy piece of apparatus can be made in this way and improved by attaching the square of card-board to a short length of string and a screw-eye as indicated in the drawing.



The "Simplest" Constant Ringing Bell Attachment—a Piece of Cardboard Placed Between Armature and Contact Screw.

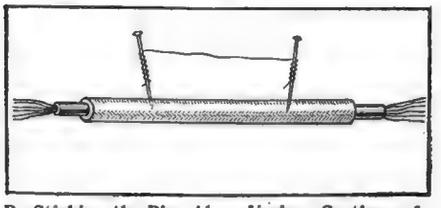
To operate the bell, press and release push button (D), which closes the circuit and thereby draws the armature away from the adjusting post (C). This allows the card-board to drop, which closes the regular vibrating circuit of the bell.

Contributed by
CHARLES W. CHRISTMAN.

QUICK TEST FOR "OPENS" IN INSULATED WIRES.

The constant vibration of an automobile and certain other machines in time will often result in the breaking of electrical wires within their casings. These breaks are difficult to locate in many instances without removing the insulation and damaging the entire wiring system, necessitating a complete rewiring of the engine in many cases.

To locate the break quickly and without



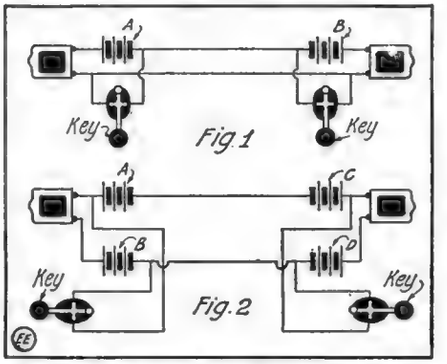
By Sticking the Pins Along Various Sections of a Cable the Location of an "Open" is Soon Made Known by the Ringing of a Bell, etc.

cutting the covering use a short piece of wire having a pin attached to each end. The pins are stuck into the wire thru the insulation at different places until the break is found, as evidenced by the spark coil operating or ringing of the bell, if a bell and battery are hooked up across the two ends of the "open" cable. It is then only necessary to cut the insulation at the break, make the repair and cover it with tape.

Contributed by KARL WEGNER.

A BUZZER LINE WITHOUT ANY SWITCHES.

In Fig. 1 batteries A and B balance each other and no current is consumed. If either of the keys were closed both buzzers would ring. This hook-up is best suited for a two-party line. In hook-up No. 2 batteries A B C and D balance each other.



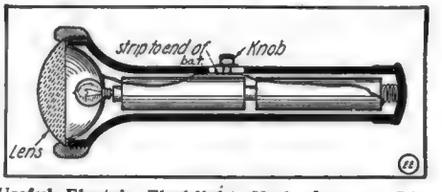
A Buzzer Telegraph Line Utilizing Opposing Batteries and Thus Eliminating Change-over Switches.

As in Fig. 1, if either of the keys are closed both buzzers ring. This hook-up can be used on a line with two or more stations. These schemes eliminate the bothersome switches used in an ordinary circuit. Sounders may be substituted for the buzzer.

Contributed by FRANK WALCUTT.

FLASHLIGHT MADE FROM TELEPHONE RECEIVER SHELL.

If you have an old telephone receiver case and would like to make a flashlight, proceed as follows: Remove the cap that holds the diafram and cut hole as large as desired for the lens. As shown in a previous issue of THE ELECTRICAL EXPERIMENTER, make a parabolic reflector. The screw socket is made as shown in the il-



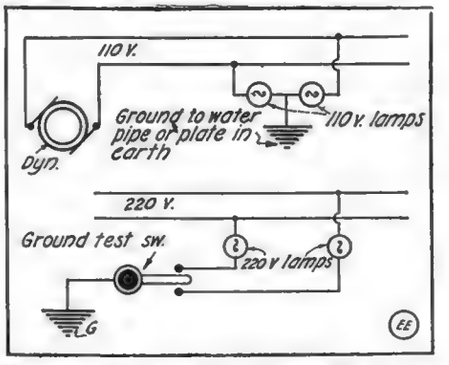
Useful Electric Flashlight Made from a Discarded Telephone Receiver Shell.

lustration, No. 14 copper or iron wire being soldered to the side of the hole. The lens will have to be bought. Note the illustration for the switch attachment.

Contributed by THEODORE BELL.

"GROUND" DETECTING LAMPS FOR SWITCHBOARDS.

It is often desirable and in fact vitally necessary to know just when you have a *ground* leak on your power line, no matter



Method of Connecting Up "Ground" Detecting Lamps on Radio and Electrical Distribution Switchboards.

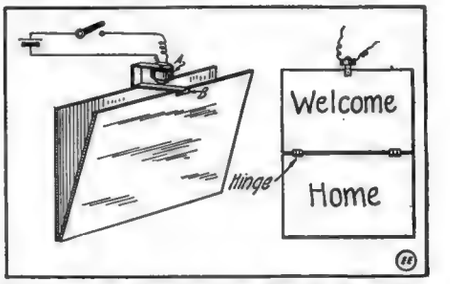
whether it is from your private lighting switch-board or a radio or laboratory panel. If outside or commercial current is used you of course will have no use for this indicator.

It is usual to connect up two 110 volt incandescent lamps as shown in the illustration. Normally they both burn at half brilliancy, but if one of them flashes up bright, then there is a *ground* leak on the opposite line to which the lamp is connected. In some plants these lamps are connected to a plug or knife switch and a test is made once a day for such trouble.

Contributed by
BYRON H. WILLIAMS.

AN ELECTRIC DROP SIGN.

Electrical experimenters will, perhaps, be interested in this simple idea. It consists of a small telephone-receiver magnet A, a small catch B, made of soft sheet iron and a thick piece of cardboard on which suit-



It is Easy to Construct an Electric Drop Sign Like This. The Electro-magnet, when Energized, Releases the Catch "B."

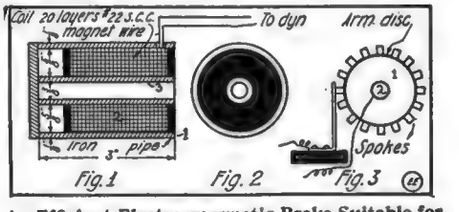
able lettering is printed. If desired the whole may be mounted on a board or placed on the wall. The illustration shows its appearance before the button is prest and after it has been prest.

Contributed by KARL WAGNER.

A USEFUL MAGNETIC BRAKE FOR AMATEURS.

As we all know, a magnetic brake, properly applied to a rotary spark gap, or a spark gap hook-up, is more easily and rapidly operated than a friction brake.

If a small battery motor is used the armature can be moved on the shaft so that one-eighth of an inch of the shaft projects from the bearing. A hole can be tapt into the shaft of the motor to hold the 1/16-inch thick iron or steel disc, 1, Fig. 3. The magnet is made as shown in sketch. This magnet support is pivoted



An Efficient Electro-magnetic Brake Suitable for Rotary Spark Gaps and Other Apparatus, where a Quick Stop Is Wanted.

and a spring presses against it, holding the magnets about 1/32 inch or less from the disc.

It is an advantage to use a vibratory action on the armature. The brake stops the motor so quickly that if the circuit is not immediately broken the motor will be stopt with a jerk. However, if a vibrator is provided as shown in the illustration, the motor will not be stopt instantaneously. Either a foot switch or an attachment on the antenna switch may be used to close the circuit when the motor is to be stopt. Only one or two dry cells are required for the brake, and when little energy is used they will last for a very long time.

Contributed by M. D. PERELMAN.

"ELECTRO" WIRE

New York, December 20th, 1916

TO MY FRIENDS:

When this ad. had gone to press last month, we had ready and in stock a large quantity of the articles as shown on these two pages.

Then on the night of December 7th a disastrous fire, originating in our factory, devastated our entire factory and all stock-rooms as well as our store rooms, wiping out at a stroke our entire Christmas Business for which we had prepared the entire summer.

May I ask my friends whom we disappointed to be patient with us during this time of misfortune which befell my company and and all of its workers.

At this writing we have cleared most of the wreckage and by January 10th our factory will be running again full blast.

Manufacturers of raw, materials, wood, and metal pieces which we do not make ourselves, have responded splendidly to our urgent telegrams calling for immediate duplication of goods; already huge shipments are arriving from all parts of the country by Express. In a few weeks, the fire will have been forgotten by us, disastrous as it was, it doing an estimated damage of $50,000.

Remember that by the time you see this "ad" we will be running again in good order—barring an earthquake or another fire. Therefore send us your orders by all means. I will personally see to it that you will be fully satisfied.

Sincerely yours,

THE ELECTRO IMPORTING CO.

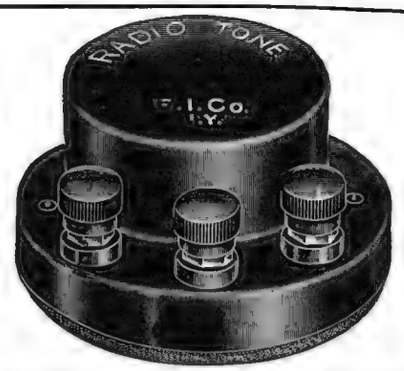
H. GERNSBACK, President

PATENTS PENDING

Our "Government" Receivers have for years been a standard for all to look up to. They have aluminum shells, perfect diaphragms, 5 ft. silk cord and are now supplied with the wonderful "Gernsback Adjustable" Headband. Shipping weight, 3 lbs. Ready January 25

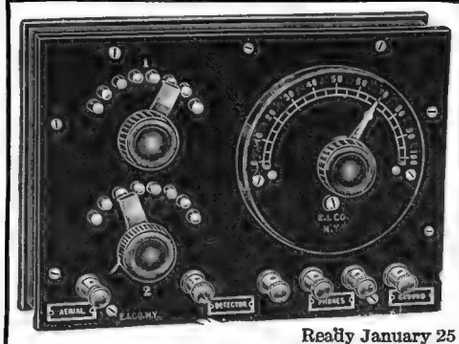
No. GX—6666 "Government" Wireless Receivers..... **$7.00**

OUR XMAS PRESENT WAS A FIRE



The Electro Radio Tone. The newest thing in wireless. A perfect test buzzer at last. Has rubber composition case, **is absolutely noiseless,** gives a beautiful high pitched musical note and can't get out of adjustment. Our catalog shows several new uses for this instrument. As always, it is the best on the market. Shipping weight, 4 oz. **Ready for delivery January 30th, 1917.**

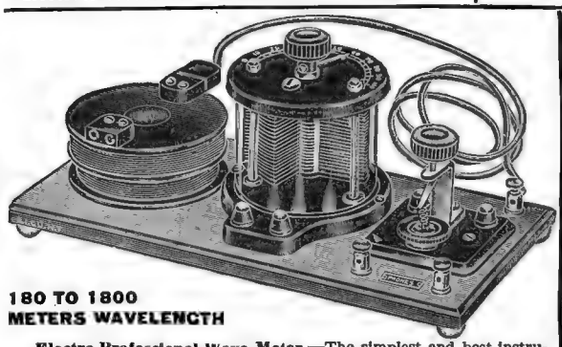
No. HX-1800 Electro Radio Tone..... **$0.80**



Ready January 25

Arlington (NAA) Baby Timer. 1200 meters wavelength. All that its name implies and more. Receives long waves perfectly. Has **Bakelite** front and hand-rubbed **mahogany** case. All metal nickel plated and polished. Size, 3¾x6x2.

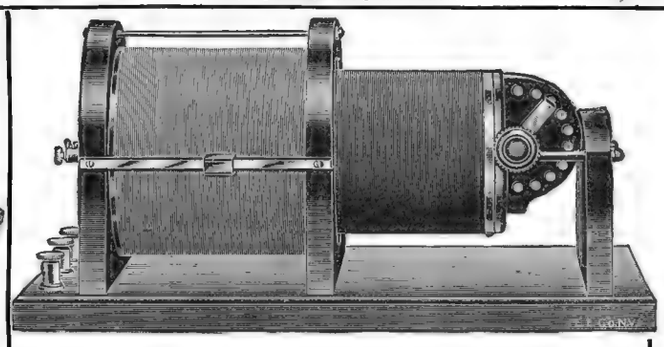
No. HEK-4433 Arlington (NAA) Baby Timer (no phones). Weight, 4 lbs..... **$8.50**



180 TO 1800 METERS WAVELENGTH

Electro Professional Wave Meter.—The simplest and best instrument of its kind ever offered the public. Has two exploring coils for different capacities. Is supplied complete as shown with full directions and calibration curves. Woodwork hand-rubbed mahogany. Shipping weight, 10 lbs. Reads from 180 to 1800 meters. Accurate to within 3%. Ready for delivery Jan. 1st, 1917 Ready January 25

No. HZ-4485 "Professional" Wave Meter..... **$8.00**



Professional Loose Coupler. The 1917 model of the best coupler on the market at its price. Note the size, 15½x7½x7¼. Tunes up to 3000 meters easily. Navy type switch on secondary with 10 points. Shipping weight, 10 lbs. Ready January 25.

No. HX-14000 Professional Loose Coupler..... **$8.00**

THE ELECTRO IMPORTING CO.

Patent
No. 842,
Feb 5, 19
No. 902,
Oct 27, 19
No. 948,
Feb 1, 19
No. 951,
Mar. 8, 19
No. 961,
June 21.
No. 978,
Dec 20,
No 988,
April 4, 1
No 988,
April 4, 1
No 1,016,
Jan 30.
No 1,033
July 23.
No 1,057
April 1.
No 1,124
Jan 12.
No 94,9
Jan 20.
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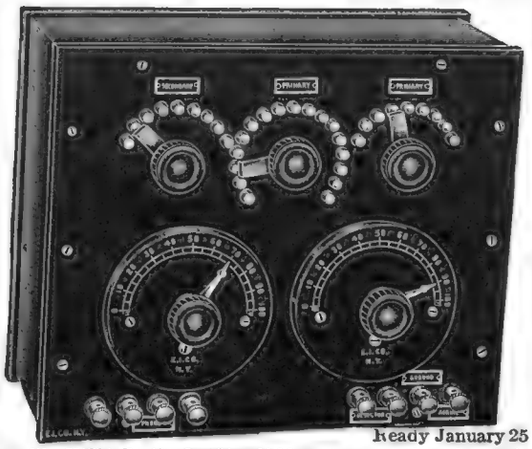
LESS NEWS

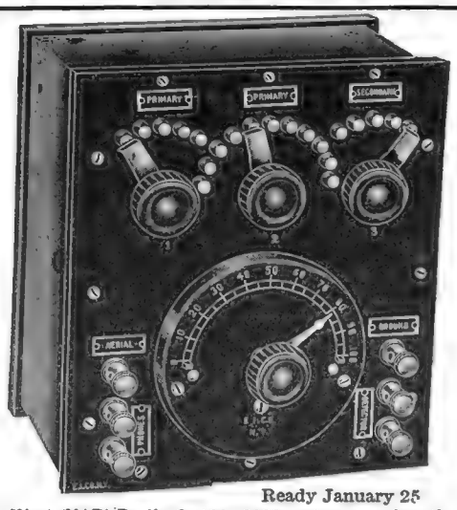


Ready January 25

Sayville (WSL) Radio Outfit. 2500 meters wavelength. A de luxe cabinet that is compact, efficient, good looking and yet is not expensive. All tuning is by switches, and the front is of **Bakelite**, the metal highly nickeled and the case is of hand-rubbed **mahogany.** Size, 12x10x5½. Shipping weight, 9 lbs.
No. AHX-4455 Sayville (WSL) Radio Outfit (no phones) **$18.00**

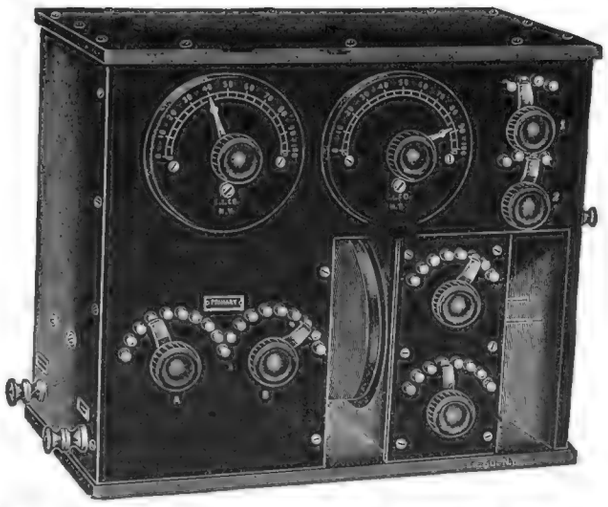
GOLD WIRE CATWHISKER

Radiocite Detector. The newest and best on the market. Most easily adjusted and **only one that LOCKS its adjustment.** Radiocite crystal furnished; also **solid gold** catwhisker. Heavy **Bakelite** base. Shipping weight, 3 lbs.
Ready January 25
No. CEK-8888 Radiocite Detector **$3.50**

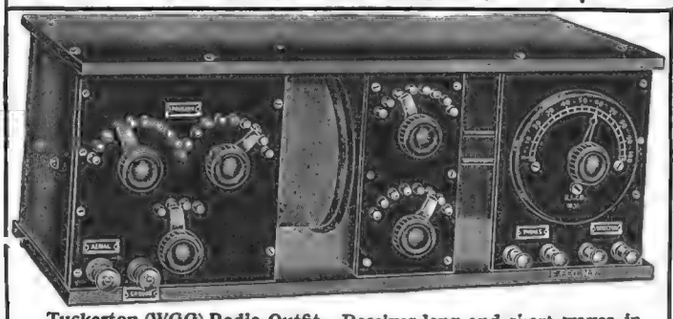


Ready January 25

Key West (NAR) Radio Outfit. 2000 meters wavelength. Combines more value in a small outfit than any outfit we make. Has made some wonderful long records in tests. **Bakelite** front, nickeled metal, and hand-rubbed **mahogany** case. Size, 8x8x4½. Shipping weight, 6 lbs.
No. ADX-4444 Key West (NAR) Radio Outfit (no phones) **$14.00**



Nauen (POZ) Radio Outfit. 3500 meters wavelength. Made to do just what its name implies, to receive European messages, **and does it.** Has a remarkable Navy type receiving transformer and condensers. Entire front of **Bakelite**, metal highly nickeled and case, size 17½x11½x7, is of hand-rubbed **mahogany.** A perfect instrument at a very reasonable price. Receives up to 3500 meters without extra coils. A real bargain
No. CIX-04477 Nauen (POZ) Radio Outfit (no phones) **$39.00**
Ready January 25



Tuckerton (WGG) Radio Outfit. Receives long and short waves in great style. Has the most wonderful Navy type loose coupler you have ever seen. All fronts of **Bakelite**, metal nickeled and case of hand-rubbed **mahogany.** Size, 21½x7x6¾ in. Shipping wt., 15 lbs.
No. BVX-4466 Tuckerton (WGG) Radio Outfit (no phones). **$26.00**
Ready January 25

FREE

Yes, entirely free. Our big, new electrical cyclopedia No 18 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 200 Big Pages, 600 illustrations, 500 instruments and apparatus, etc. **New Art Section** contains finest Radio Outfits made. Big **"Treatise on Wireless Telegraphy."** 20 FREE coupons for your 160-page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 18 measures 7x5¼". Weight ½ lb. Beautiful stiff covers.

"THE LIVEST CATALOG IN AMERICA"

Now before you turn this page write your name and address on margin below, cut or tear out, paste on postal card and the Cyclopedia is yours by return mail.

THE ELECTRO IMPORTING CO., 236 Fulton St., N. Y. C

6 FULTON ST., NEW YORK, N. Y.

Experimental Chemistry

By Albert W. Wilsdon

Ninth Lesson

NITROGEN.

NITROGEN [N] is a colorless, odorless, and tasteless gas. It is fourteen times heavier than Hydrogen, and was discovered in 1772 by Daniel Rutherford, a young English medical student. The experiments which he performed consisted of placing live mice in a confined portion of air. He found that after a short time the mice died, due to suffocation from the lack of oxygen, all of which had been absorbed by them. We can readily see by reference to the "Relation to Life" described in the previous article on Oxygen [October, 1916, issue of THE ELECTRICAL EXPERIMENTER], that the mice exhaled *Carbon Dioxid* [CO_2]. In order to get rid of the Carbon Dioxid, Rutherford absorbed it by adding a solution of *Sodium Hydroxid.* The nitrogen was thus isolated for the first time.

Nitrogen evidently derives its name from the Greek words Nitron [Nitre] and Gen [to produce] apparently due to its being an essential constituent of Nitre [Potassium Nitrat [KNO_3]]. Rutherford termed this gas *Phlogisticat d Air,* and later Lavoisier called it *Mephitic Air,* later changing the name to *Azote,* in consequence of its being a gas incapable of supporting life.

We are indebted to J. A. Chaptal for the name *Nitrogen* which it now retains.

Occurrence.

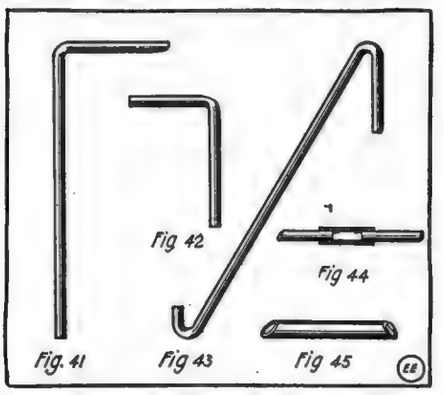
It occurs in a free state [uncombined] in the air, 78% by volume and 75.539 parts by weight.

It is a constant and essential constituent of all living organisms, as most animal and plant tissues. All life seems to depend upon the transformation of proteid compounds.

It is also combined in Ammonia, nitre [Potassium Nitrat], and also in the ammonium compounds, nitrates, nitrites, etc., and in a great many animal and vegetable products, i.e., whites of eggs, proteids, etc.

Relation to Life.

Nitrogen is not poisonous, and can be inhaled with oxygen without any harmful effects, as shown when we consider that the atmosphere contains 78% by volume. It does not support respiration by itself, and living organisms placed in it die, not because the gas is poisonous, but due to the fact that Oxygen is not available, and they are overcome by suffocation.

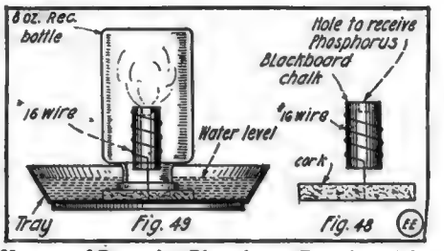


Various Shapes of Glass and Rubber Tubes Required in Conducting "Nitrogen" Experiments Here Described.

Preparation.

1. From Ammonium Nitrit [NH_4NO_2].

$$\underset{\text{Ammonium Nitrit}}{NH_4NO_2} = \underset{\text{Water}}{2H_2O} + \underset{\text{Nitrogen}}{2N}$$



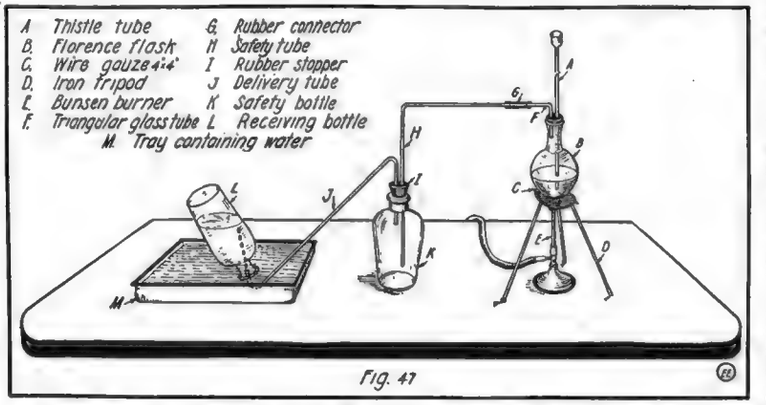
Manner of Preparing Phosphorus Experiment for Producing "Nitrogen Gas."

2. From Ammonia [NH_3] and Bromin [Br] in solution;

3. By heating Ammonium Dichromat [$(NH_4)_2Cr_2O_7$].

$$\underset{\text{Ammonium Dichromat}}{(NH_4)_2Cr_2O_7} = \underset{\text{Chromium Trioxid}}{Cr_2O_3} + \underset{\text{Water}}{4H_2O} + \underset{\text{Nitrogen}}{N_2}$$

4. By heating Ammonium Chlorid [NH_4Cl] and Sodium or Potassium Nitrit.



Apparatus Set Up for the Preparation of "Nitrogen" From Ammonium Chlorid and Potassium Nitrit.

$$\underset{\text{Ammonium Chlorid}}{NH_4Cl} + \underset{\text{Sodium Nitrit}}{NaNO_2} = \underset{\text{Sodium Chlorid}}{NaCl} + \underset{\text{Water}}{2H_2O} + \underset{\text{Nitrogen}}{2N}.$$

Or:

$$\underset{\text{Ammonium Chlorid}}{NH_4Cl} + \underset{\text{Potassium Nitrit}}{KNO_2} = \underset{\text{Potassium Chlorid}}{KCl} + \underset{\text{Water}}{2H_2O} + \underset{\text{Nitrogen}}{2N}.$$

5. From Potassium Nitrat and Iron Powder.

6. From Ammonium Chlorid and Potassium Dichromat—

$$\underset{\text{Ammonium Chlorid}}{2NH_4Cl} + \underset{\text{Potassium Dichromat}}{K_2Cr_2O_7} = \underset{\text{Chromium Trioxid}}{Cr_2O_3} + \underset{\text{Potassium Chlorid}}{2KCl} + \underset{\text{Water}}{4H_2O} + \underset{\text{Nitrogen}}{N2}.$$

7. [See Note—] When Chlorin gas is past thru a solution of Ammonia [great care has to be taken to keep the Ammonia in excess, thus preventing the possible formation of Nitrogen Chlorid].

$$\underset{\text{Ammonia}}{2NH_3} + \underset{\text{Chlorin}}{3Cl_2} = \underset{\text{Hydrochloric Acid}}{6HCl} + \underset{\text{Nitrogen}}{N_2}$$

[Note:—This is not to be performed, as Nitrogen Chlorid is an ultra-high explosive, and decomposes with intense violence when heated above 90° or even when exposed to direct sunlight, or when brought into the slightest contact with many substances. Very few persons ever experiment with this compound due to its highly explosive properties.]

8. By removing the oxygen from the air—

[a] By the reaction of Phosphorus.

$$\underset{\text{Phosphorus}}{2P} + \underset{\text{Oxygen}}{5O} = \underset{\text{Phosphorus Pentoxid}}{P_2O_5}$$

[b] By red hot copper, iron, carbon, etcetera.

9. By the liquefaction of air.

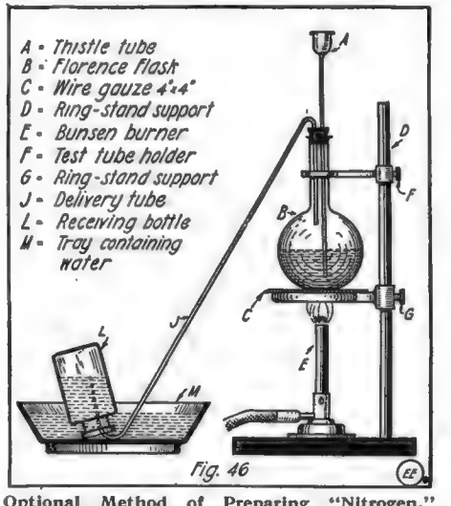
Properties.

[a] PHYSICAL:—

1. It is a colorless, odorless, and tasteless gas, not quite as heavy as air.
2. One liter under normal conditions weighs approximately 1.25 grams.
3. The atomic weight of Nitrogen is 14.01, or approximately 14.
4. 100 volumes of water at O° absorb 2.4 volumes of gas.
5. It has been liquified to a colorless liquid which boils at about —195° at ordinary atmospheric pressure. It has been solidified to a snow-white mass, which melts at —214°.
6. It is not poisonous, and does not support life.

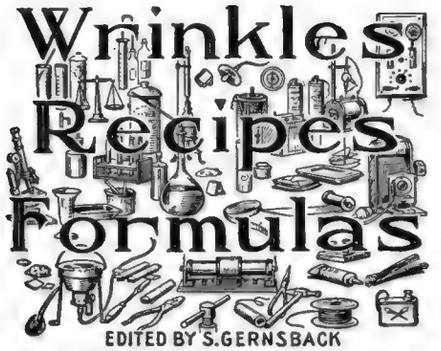
[b] CHEMICAL:—

1. It is an inert, non-combustible gas, and a non-supporter of combustion.
2. It does not combine readily with many substances, and its compounds are easily decomposed.
3. It unites with but few elements, i.e., Boron [B]; Silicon [Si]; and Magnesium [Mg], at high temperatures, and sometimes an electric spark is required to cause combination.
4. By causing electric sparks to pass thru the mixture Nitogen may be combined very slowly with Oxygen. The oxides which form during the process must be removed by dissolving them in water, otherwise the heat produced by succeeding sparks would rapidly decompose them. When sparks are past thru a mixture of Nitrogen and Oxygen or Hydrogen, these elements form in the first case Nitric Acid [HNO_3] and in the latter Ammonia [NH_3].
5. Nitrogen Compounds, notably Nitrogen Chlorid, Gunpowder, Nitroglycerine, Picric Acid, and certain other compounds are highly explosive. Due to the inertness of the elements Nitrogen, suddenly break up when struck, or when the temperature is increased, or if a spark is introduced, and form what is termed an explosion. This is caused by the Nitrogen and other


A - Thistle tube
B - Florence flask
C - Wire gauze 4"x4"
D - Ring-stand support
E - Bunsen burner
F - Test tube holder
G - Ring-stand support
J - Delivery tube
L - Receiving bottle
M - Tray containing water
Fig. 46

Optional Method of Preparing "Nitrogen," Eliminating the Safety Bottle Shown in Fig. 47.

(*Continued on page 772*)



EDITED BY S. GERNSBACK

Under this heading we publish every month useful information in Mechanics, Electricity and Chemistry. We shall be pleased, of course, to have our readers send us any recipes, formulas, wrinkles, new ideas, etc., useful to the experimenter, which will be duly paid for, upon publication, if acceptable.

SILVER AND GOLD INK.

A beautiful gold ink may be made as follows:

Honey and gold leaf, equal parts; add turpentine until the gold is reduced to the finest possible state of division. Agitate with thirty parts hot water and allow to settle; decant the water and repeat the washing several times and finally dry the gold leaf and mix it with a little gum water for use.

Silver Ink.—For silver ink the process is the same as for gold, substituting silver leaf for the gold leaf.

Luminous Ink.—The following ink is luminous or shines in the dark: Phosphorous, ½ dram, oil of cinnamon, ½ ounce. Mix in a vial, cork tightly and heat slowly until mixed.

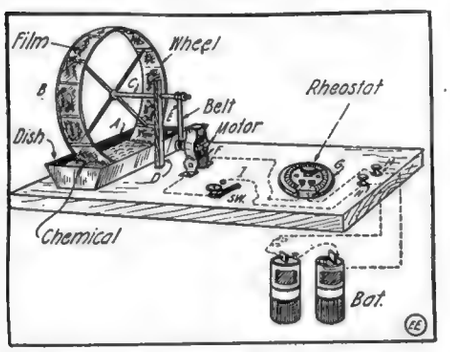
A letter written in this ink can only be read in a dark place, when the writing will have the appearance of fire.

Contributed by
W. BENNETT CHAPMAN.

AN ELECTRIC FILM DEVELOPER.

Many of us enjoy taking pictures but there are few who can afford a film tank, and we have to develop by hand in a *stuffy* dark room. To obviate this difficulty I devised the following instrument. All the materials can be obtained around the house and can be put together in a few minutes.

First the wheel B is assembled on rod C, which rotates through a hole in rod D. The rod C is turned by belt E (a rubber band can be used) which is made to rotate by a small battery motor F. Care must be taken that the motor does not run too fast while you are developing a film. To overcome this trouble a rheostat G is



Useful Scheme Employing Battery Motor for Moving Photographic Film Thru Developing Bath.

put in the battery circuit. The starting switch I, binding-posts H and one or two batteries complete the outfit.

It is clear how the film drum is made. When the dish A is removed the wheel B can be revolved at high speed. This will dry the film very quickly. This device is also good for amateur motion picture developing.

Contributed by WILBUR R. CRAMER.

HOW TO TREAT STORED ACCUMULATORS.

Bearing in mind that the result desired is always the preservation of the accumulator plates, the advice always depends upon whether the owner desires to keep his accumulator in good condition with as little disturbance as possible of its working state, or whether he desires to store it for a long period of time and does not object to the trouble involved in removing the acid and refilling again when the battery is to be put in use again, says *The Motor.*

There are two methods, the dry system and the liquid system, the former being the better. For the dry system give the battery a thoroly good charge in order to bring all the plates into a satisfactory state. Then remove the acid, fill up again with pure water, discharge the battery for a few hours until the voltage has fallen by 10 per cent, and then immediately empty out the water, let the cells drain as much as possible, remove the terminals, wash away any traces of acid on the top covers, put a little vaseline on the terminal stems and all connections, and store in a place free from dust.

The object of discharging after the water has been added is to avoid heating of the negative plates when the cells are dry. The object of putting water in the cells for the discharge is for the purpose of thoroly removing the acid in the pores of the plates. On no account leave the water in the cells, whether charged or discharged, as they will rapidly sulfate if you do. Advice is sometimes given to fill cells with water and leave it in. This is absolutely wrong.

The liquid system is as follows:—See that the plates are well covered with acid, but keep it below the lead connecting bars inside the cells. Charge up the battery until it is thoroly well charged. Remove the terminals and vents, carefully clean the tops of cells, vaseline all metal parts and store in the dark, with protection from dust. A periodical charge is beneficial, but not always necessary; this depends upon the condition of the battery when stored, the type of plates, and the amount of loose sediment there may be in the cells. If the voltage is found to be low after a few weeks, it is a sign that the battery requires attention.

STAINS OF ALL KINDS.

The following formulas are used by many furniture manufacturers:

1. *Deep brown* on oak can be obtained by giving the wood a coat of iron thoride, and when dry a coat of ammonium sulfide. This is darkened with tannic acid.

2. *Analine mahogany*—One-half ounce Bismark brown in three pints of boiling water. This is darkened with tannic acid.

3. *Chinese Brown Mahogany*—Boil logwood chips in twice their bulk of water, for two hours; strain and add a small quantity of chlorid of tin.

4. *Vandyke brown* 1 oz., burnt umber, ¾ oz., aqua ammonia, 4 oz. Mix in open air to avoid fumes, strain and apply.

5. *To brighten stain*—Nitric acid ½ oz., hydrochloric acid ½ oz., rain water 1 oz. Mix several days before using.

6. *Brown-Black*—Logwood powder 1 oz., iron sulfate 1 oz. Apply separately in washes in order named.

7. *Finishing Wax*—1 lb. best beeswax, 2 lbs. turpentine. Place in a vessel and heat separately. Do not place over a fire.

8. *Metal varnish*—One part copal, 1 part oil of rosemary, in 2 or 3 pints of absolute alcohol. This should be applied while hot.

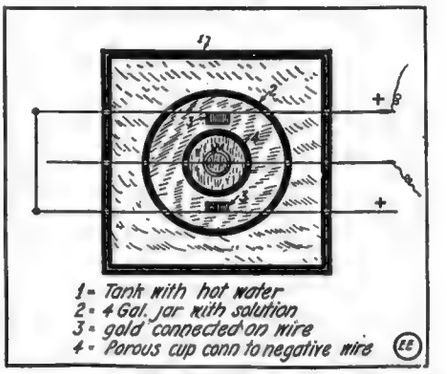
9. *Polish*—One pint boiled oil, 4 oz. vinegar, 2 oz. spirits of camphor, 1 oz. ammonia, ½ oz. antimony. Shake and let stand 2 or 3 days before using.

10. *Glue* (Fire and Water Proof)—Mix one handful of quicklime with 4 oz. linseed oil. Mix thoroughly, boil to a good thickness, and spread in pans in the shade to harden. To use, melt and apply.

Contributed by VICTOR STAPEL.

"ROMAN GOLD" PLATING SOLUTION.

When making the solution, obtain a porcelain jar that holds 4 gallons of water.



Arrangement of Apparatus for "Roman Gold" Plating.

Fill it almost to the top with clean water and set the jar in a tank of water. Keep the water boiling while you are using the solution, for if the solution is cold the work will smut up, instead of having an even Roman Gold finish. Next dissolve 8 ounces of potassium cyanide in the 4-gallon jar. After the cyanide is all dissolved place into the 4-gallon jar a porous cup that holds about 1 quart of water. Into the porous cup pour 4 ounces of cyanide; let this dissolve also. Suspend the porous cup on center wire as per diagram. Put 10 pwt. of fine ribbon gold on both sides of the electric wire, making 20 pwt. in all. The gold will dissolve into the 4-gallon jar in about one hour and a half. After it is all dissolved remove the porous cup from the 4-gallon jar and throw away what is left, as it is of no value. Allow the solution to settle about 2 hours before using. You can use gold, platinum or carbon anodes to color with; that is to say, put one anode on each wire, and color on center wire.

Contributed by EMERY MALO.

REMOVING GLASS STOPPERS.

Take a piece of wood about 12 inches long, 1 inch wide and ⅛ inch thick (an ordinary light ruler is just the thing), hold the bottle upright, either on the bench or in the hand, tap the under side of the shoulder of stopper a few minutes with the edge of the piece of wood or rule, first one side and then the other, says *The Amateur Photographer's Weekly.* It will then be found that it is quite easy to remove the stopper with the fingers.

A "COST-LESS" NIGHT LAMP.

I bought a small bell-ringing transformer that gives three voltages on the secondary, also a 14 volt Christmas tree lamp. I then purchased a wall socket that would hold this bulb and connected the wall socket to the 14 volt terminals of the transformer. Having connected the transformer to the 110 volt A.C. current, I inserted my bulb. The result was a light that illuminates the whole house sufficiently at night. I have operated this same bulb every night, all night long, for the past three years. The amount of current used scarcely causes the meter to move.

Contributed by RAY McCLELLEN.

WITH THE AMATEURS

Our Amateur Radio Station Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of stations unaccompanied by that of the owner. Dark photos preferred to light toned ones. We pay each month **$3.00** prize for the best photo. Make your description brief and use only one side of the sheet. Address the Editor, "With the Amateurs" Dept.

AMATEUR RADIO STATION CONTEST.

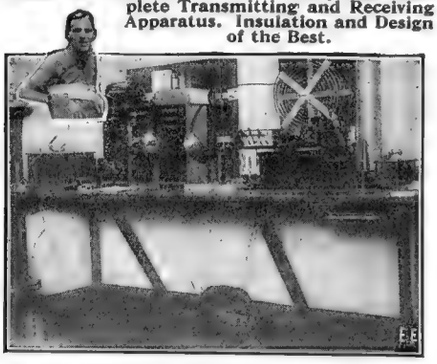
Monthly Prize, $3.00.

This month's prize-winner.

C. F. OUDIN A SCHENECTADY, N.Y., RADIO EXPERT.

The receiving set at the left consists of a cabinet set with two Audions acting as a double amplifier. The cabinet set con-

Well Arranged Wireless Station of Mr. C. F. Oudin, of Schenectady, N. Y. Comprises Complete Transmitting and Receiving Apparatus. Insulation and Design of the Best.



sists of a 2,500 meter loose coupler, with loading coil and secondary variable condenser, and a galena detector with the amplifying Audion controlled by S.P.D.T. switch. The Audion at the left is used to amplify the results from this set still more. The loose coupler was especially made to be sensitive to 600 meter stations and amateurs, but by means of the large VC and loader the signals from NAA come in very well.

This set represents the last word in efficiency, as all connections are of stranded wire—*soldered*—and all metal parts, switches, etc., *silver plated*.

Signals are heard from all Commercial and Navy stations, from Cape Race and Isle Royal to Key West and Miami, while amateurs in the second and even the eighth districts have been copied. One important feature of this set is that in no place does any part of the receiving circuit involve the use of other than hard rubber or Bakelite for insulation.

A portable set is shown on top of the cabinet. As D.C. only was available it was necessary to install a rotary converter. A fixt resistance in the field gave about 250 watts at 200 cycles. The ¼ K.W. transformer is of the Blitzen type, while three sections of molded condenser keep the wave below 200 meters. The large surface and short length of the leads still further raise the efficiency. The rotary gap and oscillation transformer were homemade. A spark coil was used for short-distance work. The aerial consists of 4 wires, spaced six feet apart, 42 feet long, 70 feet high at one end and 55 feet high at the lead-in end. The aerial is super-insulated.

This set while using small power, below 200 meters in wave length, has done some wonderful work.

Schenectady, N.Y. C. F. OUDIN.

MR. SHEDD HEARS GERMANY.

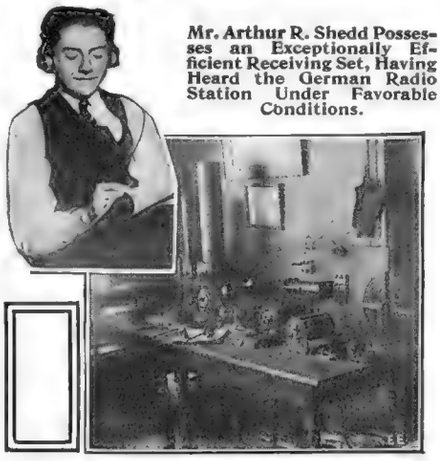
The accompanying is a photograph of my radio station, 8AEP. The transmitting apparatus, which is shown at the right, consists of a one-inch Bull-Dog spark coil, oscillation transformer, glass plate condenser and fixt gap.

With this outfit I have *worked* a distance of 20 miles from here and also 8ZN, a distance of 25 miles, both stations being worked in broad daylight and a 6 volt, 100 A.H. storage battery supplies the transmitting current.

With the receiving outfit for spark systems shown on the right, I use an Audiotron detector set of my own construction, loose coupler and a pair of 2,800 ohm Brandes' 'phones. NAA can be *heard 40 feet* from the 'phones; NAV also comes in loud, along with all other coast stations, many amateurs being heard.

On the left can be seen the undamped wave set and it is all of my own design; it consists of a large loose coupler, special oscillating Audiotron bulb, two large loading coils and three variable condensers equipt with large insulated handles.

Mr. Arthur R. Shedd Possesses an Exceptionally Efficient Receiving Set, Having Heard the German Radio Station Under Favorable Conditions.



Most all undamped wave stations in the United States can be heard, and Hanover and Nauen, Germany, are heard when the static and induction are not too heavy.

Two aerials are used, one of a two hundred meters wave length for working amateurs, etc., and a large one, which consists of two wires 250 feet long with a lead-in 150 feet long for receiving from the undamped wave stations, both aerials having an altitude of 45 feet.

Butler, Pa. ARTHUR R. SHEDD.

Has your station photo appeared in "The Electrical Experimenter"? Why not purchase the electrotype and have some "real" stationery printed with your station picture on it? All of the "regular radio-bugs" are doing it.

TUFTS COLLEGE SENDS MUSIC BY RADIO.

An interesting development in the field of wireless has been the transmission of music by wireless telephones. Very special apparatus is necessary at the sending station, but ordinary wireless receiving sets are required in order to hear the music.

At Tufts College experimenters are using a De Forest oscillion bulb to provide the necessary high frequency current. They have improved the method of introducing the voice to the high frequency. By this method music may be reproduced by a phonograph and transmitted hundreds of miles by wireless and yet sound better and clearer than if the hearer were only a few feet from the phonograph.

The scratching noise is entirely eliminated, for it is not transmitted by the wireless sender.

FRED B. ANCONA'S WIRELESS LABORATORY.

The sending set of my station consists of a ½ K.W. closed core transformer, three Murdock molded condenser sections, rotary gap, oscillation transformer and key. The small, single-throw knife switches are for the rotary gap and for regulating the power input to the transformer. The whole set is mounted on a panel of my own design and construction. The instruments are connected by means of brass strips.

The receiving set comprises a Navy type inductive tuner, 2,000 ohm 'phones, Crystaloi detector, variable condenser and a small fixt condenser. The buzzer seen in the foreground for adjusting the detector to a sensitive point is controlled by the push button beside it. The switch beside the detector is for the purpose of throwing it out of the circuit while sending.

During the summer my receiving range was about 1,000 miles and my sending radius about 25. I would like to communicate with all amateurs within my range.

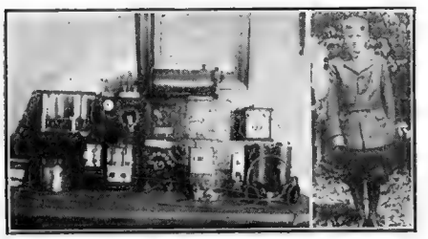
Effective and Neat Appearing Radio Laboratory Owned by F. B. Ancona, of Reading, Pa. ½ K. W. Transmitter of Panel Type

My call is 3VH, my wave length 200 meters and my hours—eight-thirty to ten p.m.

Reading, Pa. FRED B. ANCONA.

ARTHUR M. GREIM'S EXCELLENT RADIO STATION.

I present herewith photo of my radio sending and receiving sets. The transmitter consists of a 1 inch spark coil, an Elec-



Master A. M. Greim, a Rising "Radio-Bug."

tro Importing Company's sending condenser (adjustable), air-cooled spark gap and key. The coil is run on batteries. With this set I have been clearly heard ten miles away.

The receiving set includes a tuner of the slider type and a home-made, Navy type tuner with switches arranged so that either can be used. Silicon and galena detectors are used and a pole-changing switch throws either into circuit. An E. I. Co., Radioson detector is also available. There is besides a 5,000 meter loading coil, a 42 plate rotary variable condenser and a Murdock 2,000 ohm head set.

My aerial is 56 feet in length and 110 feet high, and consists of two wires spaced four feet apart on 5 foot spreaders, arranged in an inverted "L" fashion.

With this set I copy NAA's weather reports and hear the time signals very clearly. I hold a radio operator's license, Amateur first-grade; my official call is 1UV.

ARTHUR M. GREIM.

Boston, Mass.

RESULTS OF $25.00 INTERRUPTER CONTEST.

More than 130 suggestions were received and examined by us and by the party who deposited the prize of $25.00 to be paid to the person offering a suggestion worthy to be tried, but we regret to state that not one of the ideas offered came within the desideratum of the contest.

Several of the suggestions were in themselves quite clever. We were especially impressed with those submitted by Mr. Paul E. Current, Chief Electrician, U.S.N.; Mr. N. H. Holland, Staff Engineer, Edison Laboratory; Mr. Clare E. Ackley; Mr. L. Olsen of Minneapolis; Mr. Harry Sickers of El Cajon, California; Mr. F. D. Chamberlain of Chicago; Mr. Jas. Grotenhins; Mr. Thomas W. Benson of Philadelphia and Mr. Francis Feig of New York.

There was a possibility of any one of these winning the prize of $25.00 had there not been some limitation to their suggestion that made it impossible to obtain the minimum of 50 vibrations per second, or that did not permit of easy control of the vibrator, or the interruption of the current was such as to prevent the full demagnetization of the magnet, etc.

For other purposes than the one required by the judges, the suggestions of the above mentioned contestants were valuable and even worthy of development and patenting. But they could not be applied to perform successfully the special functions required in this instance.

Should any change in the device, to which the interrupter is to be applied, be made where any other requirements than the ones stated previously are necessary, then due credit will be given to the contestant whose suggestion was taken and a check for $25.00 will be sent him.

WILLIAM NORDMEYER A RADIO ENTHUSIAST.

Below is a picture of my wireless station and myself. I have constructed the set here shown entirely myself, with the exception of the receivers and spark coil. I certainly owe a great deal of my knowledge to THE ELECTRICAL EXPERIMENTER.

My receiving set consists of a loose coupler, loading coil, variable and fixt condenser and also a pair of 2,000 ohm 'phones.

My sending set comprises a 1 inch spark coil, Leyden jar, helix and key. My aerial is of 4 strands, each 100 feet long. I receive Arlington (NAA) daily and many other stations.

WILLIAM NORDMEYER, JR.

Sea Cliff, L.I.

Neat Appearing Radio Station of William Nordmeyer, Jr.

Do you belong to a Radio Club? If not, you don't know what you're missing! Hunt up your local Radio Society and join to-day.

Amateur News

The St. Paul's Amateur Radio Association, of Rochester, N.Y.

The St. Paul's Amateur Radio Association was organized in February 1916, with the following officers:

President, Frank Alexander; Vice-President, Richard Van deCarr; Secretary-Treasurer, Willis Brockett; Chairman of the Membership Committee, E. Lewis Alexander; Chairman of Purchasing Committee, Joseph Petz and Chairman of Publicity Committee, Abe Frankel.

The Association has a membership of twenty-two, nine of whom are licensed operators.

The Club has two rooms in the building at 13 Vick Park B. One room is used as a meeting room and the other is fitted up as a laboratory.

The receiving apparatus consists of a loose-coupler of home-made design, a loading inductance and variable and fixt condensers. A single step Audion amplifier is to be added as soon as sufficient funds can be obtained. The transmitting set consists of one ½-K.W. transformer, two high-potential condensers, one oscillation transformer, one rotary and one straight spark gap and two keys. The aerial is made of two strands of No. 12 copper wire, spaced three feet apart. It is 125 feet long and 75 feet high at both ends.

During the summer months a camp was held, about 8 miles up the Genesee River, for the benefit of the members. Many experiments were carried out, one of these being with a portable sending and receiving set installed on a canoe, which worked remarkably well, considering the length of the antenna.

The club would like to hear from others who may be interested. Address all communications to E. Lewis Alexander, 34 Asbury St., Rochester, N.Y.

Doings of the Tiffin (Ohio) Radio Club.

The Tiffin Radio Club of Tiffin, Ohio, has secured comfortable headquarters in the Tiffin High School and is at present installing a ¼ K.W. transformer sending set. An Audion detector is to be added to the receiving equipment. At the first meeting of the school year eight visitors were entertained, who contemplate joining the club.

The following were elected to office in July, 1916:

Murel Sager, President; Brooks Peters, Vice-President; Ronald Morgenstein, Secretary-Treasurer, and Paul E. Grederick, Club Operator.

The Uniontown, Pa., Radio Association.

Realizing the need of an organized band of Radio amateurs of the surrounding country, Professor D. H. Conway recently called a meeting in the local High School, to which about 60 local amateurs from all parts of Fayette County responded. A club called The Uniontown Radio Association was formed and officers for the year were elected.

The club has an Audion receiving set and a ¾ K.W. transmitter. To all interested, invitations are extended to join this club. Lectures will be delivered during the year by men well-versed in the subject of wireless. The following were elected to hold office for the coming year:

President, Frederick C. McMullen; Vice-President, Robert M. Sincock; Secretary, Selwyn Gay; Treasurer, Thomas B. Hunt; Librarian, John Heyser and Faculty Director, Professor D. H. Conway. All communications should be addressed to the secretary—Selwyn Gay, Uniontown, Pa.

Randall Park Radio Club.

The Randall Park Radio Club was formed March 11, 1916. The officers are Raymond Murley, President; Paul Cartwright, Secretary; Kenneth Vought, Treasurer.

The club's set consists of an extra large loose coupler, silicon detector, Jr. fixt condenser, E. I. Co. fixt variable condenser, 3,000-ohm Murdock 'phones and a buzzer test.

All communications should be addrest to the Secretary, Paul Cartwright, 84 North Ocean Avenue, Freeport, L.I., N.Y.

RADIO CLUBS ATTENTION!

We are always pleased to hear from young Edisons and Radio Clubs. Send a write-up of your Club with photos of members and apparatus to-day to: Editor "Amateur News" Section, The Electrical Experimenter, 233 Fulton St., New York City.

The Crescent Bay Radio Association, Santa Monica, Cal.

The Crescent Bay Radio Association was recently formed at Santa Monica, Cal., and the following officers were elected:—

Thomas J. P. Shannon, President and Chief Engineer; George G. Cole, 1st Vice-President; Herbert Bohme, 2nd Vice-President; Elmer Forsythe, 3rd Vice-President and Secretary-Treasurer; Phillip Leigh, General Manager and Harold Bull; Chief Operator.

The Association will be run on an entirely new plan.

The officers will act as a board of directors and govern affairs on the same plan as all companies. The prospects look as though it will be an easy matter to get applicants as many were anxious to join the association when the plans were first outlined.

The main office will be at the home of the president—Thomas J. P. Shannon, 1148 Fifth St., Santa Monica, Cal.; he owns an excellent wireless telegraph outfit. All amateurs are requested to make application to the president. The call of the Association is 6 Q J. Meetings of the board of directors will be held every two weeks. The office is situated five blocks from the ocean and overlooks the great race course of the west where the Vanderbilt Cup and Grand Prize races are held. It is proposed to send out the position of each car in the races to all amateurs and others who wish to copy them, thereby giving them the first news of the races.

The Triangle Experimental and Research Laboratories.

At a recent meeting of the Yorkville Radio Development Association, Mr. Joseph L. Cermak, the president of this organization, proposed that a laboratory be established where the members may solve their little scientific problems. This laboratory will not only co-operate with the Yorkville Radio Development Association, but will also do work for outside amateurs. Any amateur, therefore, may send his problem, question or complaint to the various laboratory departments and relieve his mind for a few pfennigs. As for the designing of radio sets, the head of the radio department can readily design the niftiest type of transmitting or receiving set, the laboratory charging the "Radio-Bug," who desires it a very small sum for this service.

OFFICIAL LIST LICENSED RADIO AMATEURS NOT TO APPEAR UNTIL NEXT ANNUAL GOVERNMENT CALL BOOK

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of May, 1916. (Continued.)

NINTH DISTRICT—(Cont'd.)

Call Signal	Owner of station.	Location of station.	Power kilowatts.
9AHS	Ovrebo, Paul	Aneta, N. D.	1
9AHG	Payne, Howard	1201 N. 27th St., Omaha, Neb.	.5
9NC	Philipps, H. G.	240 Sheridan Rd., Hubbard Woods, Ill.	1
9AHN	Principia School	St. Louis, Mo.	1
9AGJ	Rees, John C.	1314 Cedar St., Le Mars, Ia.	.5
9AHO	Schalkhausser, Erich G.	Sterling, Neb.	1
9AGR	Seymour, Charles E.	828 Astor St., Milwaukee, Wis.	.5
9AGI	Shriner, Ralph L.	4236 Juniata St., St. Louis, Mo.	.5
9AHM	Snoke, Kenneth F.	511 E. 16th St., Davenport, Ia.	1
9AIG	Spickerman, Francis H.	Sandwich, Ill.	1
9AIH	Terry, Jas. W.	520 Schwartz St., Edwardsville, Ill.	.5
9AGB	Tylekens, Lucas, Jr.	111 N. Topping Ave., Kansas City, Mo.	.5
9PP	Voss, Lucien L.	2679 Lincoln Ave., Chicago, Ill.	.5
9AIB	Wahn, Harry	4946 N. Hoyne Ave., Chicago, Ill.	.5
9AHR	Williams, Ashley	4300 South St., Lincoln, Neb.	.5
9AGL	Zuckerman, Samuel	2119 Spruce St., Boulder, Colo.	.5
9AIE	Zuelow, Felix	Casselton, N. D.	.5

Amateur Radio Stations Licensed by the Bureau of Navigation During the Month of June, 1916.

FIRST DISTRICT

Call signal	Owner of station.	Location of station.	Power kilowatts.
1UV	Greim, Arthur M.	24 Emory Ave., Boston, Mass.	.5
1UU	Hoffman, Harry J.	8 Estrella St., Jamaica Plain, Mass.	.5
1BB	O'Connor, Cornelius T.	10 Cowperwhaite St., Cambridge, Mass.	.5
1AV	Sawyer, Harry L.	31 Newhall St., Lynn, Mass.	1
1JH	Sturtevant, Windsor	219 Florida St., Springfield, Mass.	.5
1DQ	Tilden, Paul L.	23 William St., New London, Conn.	.5
1EE	Tucker, Elton H.	121 Messer St., Providence, R. I.	.5

SECOND DISTRICT

2AP	Benson, Edwin	2567 Bedford Ave., Brooklyn, N. Y.	1
2ARY	Berger, Geo. P.	171 Parker St., Newark, N. J.	.5
2JC	Connors, James	1304 Shakespeare Ave., New York, N. Y.	.5
2ARZ	Erickson, Evald T.	Harrison, N. Y.	.5
2ASA	Genodette, H. E.	Kinderbrook, N. Y.	.5
2NR	Heuer, Wm. H.	Islip, N. Y.	.5
2BC	Harrietts, Jas. B.	4—125th St., New York, N. Y. (New York Engineering College)	1
2ASC	Hauger, Oscar	37 Zabriskie St., Haledon, N. J.	.5
2ASB	Houseworth, Chas. W.	2422 University Ave., New York, N. Y.	1
2ASE	Johnson, Axel W.	459 East 135th St., New York, N.Y.	.5
2ASG	MacBride, Wm. D.	65 Maolis Ave., Bloomfield, N. J.	.5

THIRD DISTRICT

3PE	Allen, John P.	2032 N. Capitol St., Washington, D. C.	.5
3VH	Ancona, Frederick B.	1579 Mineral Spring Rd., Reading, Pa.	.5
3AGF	Barkley, Joseph A.	2313 W. 17th St., Wilmington, Del.	1
3QX	Barrington, Roger W.	608 Park Ave., Pensauken, N. J.	.5
3IM	Behan, Arthur R.	3447 N. 15th St., Philadelphia, Pa.	.5
3EO	Bockins, John M., Jr.	Abington, Pa.	.5
3SD	Cheltenham High School	Elkins Park, Pa.	.5
3AHT	Deavers, Wayne R.	1815-A West Main St., Richmond, Va.	.5
3BI	Feiler, Frederick W.	269 W. Thayer St., Philadelphia, Pa.	.5
3EZ	Hollyday, H. Robins	120 E. Dover St., Easton, Md.	.5
3LC	Jones, Winters	728 N. Monroe St., Baltimore, Md.	.5
3WZ	Keller, Kenneth W.	159 Harrison Ave., Glenside, Pa.	.5
3SV	King, Charles E.	Calvert Court Apts., Baltimore, Md.	.5
3AHF	Martin, Justus L.	721 W. Fayette St., Baltimore, Md.	.5
3GS	Morris, Geo. M.	1511 Hazzard St., Philadelphia, Pa.	.5
3AHM	Morris, William J., Jr.	134 Prospect St., Trenton, N. J.	.5
3RJ	Oppermann, Richard	3746 N. 17th St., Philadelphia, Pa.	.5
3WC	Ort, Otto V.	1212 Delaware Ave., Wilmington, Del.	1
3AFM	Weidman, Marshall D.	Columbia, N. J.	.5

FOURTH DISTRICT

4ED	Dobbins, Walter E.	230 Ponce de Leon Ave., Atlanta, Ga.	.5
4EF	Linville, Roy R.	646 13th St., Winston-Salem, N. C.	.5
4EE	Stubbs, Wm. P.	109 E. Gwinnett St., Savannah, Ga.	.5

FIFTH DISTRICT

5EQ	Barre, Martin	St. Paul's College, Covington, La.	.5
5AR	Moore, J. Walter	317 Jackson Ave., Dorado, Ark.	1

SIXTH DISTRICT

6IB	Bauchou, Leon J.	Mayfield, Cal.	.5
6KQ	Brennan, Ralph P.	1430 Vallejo St., San Francisco, Cal.	.5
6DP	Briare, Wm. N., Jr.	Marine Barracks, Mare Island, Cal.	.5
6LS	Cooksey, Clayborne D.	1246 Birch St., Los Angeles, Cal.	.5
6QI	Crissman, Robert J.	617 S. Birch St., Santa Ana, Cal.	.5
6MO	Dargitz, Jesse L.	*Near* Acampo, Cal.	1
6OY	Dodson, Loyd O.	724 N. Chester St., Pasadena, Cal.	.5
6QH	Flaig, Philip F.	43 Mizpah Ave., San Francisco, Cal.	.5
6HN	Fredrichson, Clarence J.	Rio Vista, Cal.	.5
6QU	Garrettson, Oliver	911 Jane St., Los Angeles, Cal.	.5
6PM	Hamilton, Otto J.	1638 Bancroft Way, Berkeley, Cal.	.5
6QS	Henry, Wm. J.	554 11th Ave., San Francisco, Cal.	.5
6AEA	Johnson, Roy	414 Main St., Los Angeles, Cal.	.5
6IN	Lewelling, Raymond.	St. Helena, Cal.	1
6AFA	Richardson, Franklin	7263 Sunset Blv., Hollywood, Cal.	.5
6IQ	Robertson, Orlyn N.	202 S. Broadway, Santa Ana, Cal.	.5
6UQ	Thompson, Charles E.	1876 15th St., San Francisco, Cal.	.5
6PQ	Thornton, Geo. N.	Lancha Plana, Cal.	.5
6KS	Tilden, C. W.	1635 Maltman Ave., Los Angeles, Cal.	.5
6QP	Vodra, Geo. G.	211 S. 20th Ave., Los Angeles, Cal.	.5

SEVENTH DISTRICT

7VB	Bird, Vernon J.	406 W. 12th St., Vancouver, Wash.	.5
7TB	Borders, Lawrence	1084 Water St., Portland Oreg.	.5

SEVENTH DISTRICT—(Cont'd)

Call signal	Owner of station.	Location of station.	Power kilowatts.
7EI	Craig, Russell E.	1420 Division Ave., Tacoma, Wash.	.5
7AT	Deady, Joseph	1002 E. Jefferson St., Seattle, Wash.	.5
7EM	Divine, Louis R.	1010 E. 7th St., Vancouver, Wash.	.5
7DT	Dupea, Eldred E.	707 S. Cushman Ave., Tacoma, Wash.	.5
7VW	Fitzpatrick, George	3245 Ferdinand St., Seattle, Wash.	.5
7EK	Ives, Jesse F.	301 N. 32d St., Seattle, Wash.	.5
7BV	Joyce, Thedore W.	206 E. 19th St., North, Portland, Oreg.	.5
7BO	Keinath, Alvin	246 Going St., Portland, Oreg.	.5
7KO	Koehler, Frank A.	603 E. Davis St., Portland, Oreg.	.5
7CK	Larson, Elwood A.	733 E. 38th Ave., Spokane, Wash.	.5
7HK	Mahler, Harold E.	4730 20th Ave., N. E., Seattle, Wash.	1
7MT	Matthews, Harold L.	2922 S. Adams St., Tacoma, Wash.	.5
7DU	McCoy, Harry	116 N. Washington Ave., Centralia, Wash.	1
7OM	Ormsby, Major	438 S. Center St., Casper, Wyo.	1
7BN	Rose, Donald W.	717 Lynn Ave., Portland, Oreg.	.5
7SP	Samma, Philip C.	415 9th Ave., South, Pocatello, Idaho	1
7SL	Stinson, Leo	2428 Pacific Ave., Hoquiam, Wash.	.5
7EY	Young, Farrel	422 S. 2d St., Pocatello, Idaho.	1

EIGHTH DISTRICT

8BT	Ackerman, Edmund K.	1698 E. 90th St., Cleveland, O.	1
8AGG	Anton, Wm. G.	224 S. Rebecca St., Pittsburgh, Pa.	.5
8ADY	Atkinson, Earl W.	723 S. Arch Ave., Alliance, Ohio	.5
8ADW	Barris, Allen	R. F. D. No. 4, Silver Creek, N. Y.	.5
8AKG	Bower, Orville D.	834 4th St., Marietta, Ohio	.5
8AJT	Clement, Russell C.	168 North Ave., Washington, Pa.	1
8AIM	Darrall, Wm. G.	1112 Stanton Ave., New Kensington, Pa.	.5
8ACO	Dietsch, Carl G.	395 Avondale Ave., Toledo, Ohio.	.5
8KC	Gammon, Joseph	597 East Ave., Rochester, N. Y.	.5
8AHN	Hawks, Harry L.	Fleming, Pa.	1
8AGA	Katzenberger, Raymond.	Tippecanoe City, Ohio	1
8ACN	Kelso, Herbert F.	Dravosburg, Pa.	.5
8AEK	Kiger, Earnest W.	Williamstown, W. Va.	.5
8AFM	Kilbury, Walter A.	119 N. Greenwood St., Marion, O.	.5
8AER	Mattice, Wm. A.	105 Highland Pl., Ithaca, N. Y.	.5
8JF	Moon, Orville P.	1752 E. Erie Ave., Lorain, Ohio.	.5
8KS	Newton, Archibald E.	Cherry and Third Sts., Jamestown, N. Y.	1
8ACE	Norquist, Reynold O.	517 E. 5th St., Jamestown, N. Y.	.5
8ACD	Palmer, Roy,	333 Pennsylvania Ave., Lansing, Mich.	1
8HB	Philipps, Maynard W.	Conewango, N. Y.	.5
8AGI	Rembold, Walter O.	120 Hersehey St., Dayton, Ohio.	.5
8ADS	Schamberger, Sanford O.	24 6th Ave., Gloversville, N. Y.	1
8AEW	Shields, Robert D.	Sta. B., North High St., Columbus, Ohio.	.5
8ADN	Stradling, Fred	Hamilton, N. Y.	.5
8GE	Terbrack, John H.	3169 W. 90th St., Cleveland, Ohio.	.5
8ACI	Thomas, Frank P.	135 Brownsville Rd., Pittsburgh, Pa.	1
8ADL	Winne, Robert F.	19 Holley St., Brockport, N. Y.	1
8AGD	Wirsching, Harold A.	24 Cannon St., Dayton, Ohio.	.5
8AFG	Wood, Donald	310 Augustine St., Rochester, N. Y.	.5
8ADB	Woods, James B.	400 Wills Rd., Connellsville, Pa.	1
8AFI	Young Men's Christian Association Radio Club.	Elyria, Ohio	1

NINTH DISTRICT

9AJA	Argabrite, Geo. A.	3128 W. 32d Ave., Denver, Colo.	.5
9QI	Baldwin, Harry E.	609 S. 18th St., Omaha, Neb.	.5
9AIS	Barber, Orville F.	975 W. Packard St., Decatur, Ill.	.5
9DH	Blatterman, Headlee.	6172 Westminster Pl., St. Louis, Mo.	.5
9QC	Bundy, Howard E.	1007 S. Gallatin St., Marion, Ohio.	1
9AIV	Curtis, David S., Jr.	2400 Elisha Ave., Zion City, Ill.	.5
9AIY	Davis, Winfield	908 W. Stoughton St., Urbana, Ill.	.5
9AIW	Doole, Howard	Adams, Neb. (Partner of Lyle Francis)	.5
9PM	Eick, Ferdinand	1818 19th St., Superior, Wis.	.5
9AIQ	Englund, Lawrence	1623 24th Ave., Moline, Ill.	.5
9AIO	Ferree, Frank H.	434 E. 9th St., Alton, Ill.	.5
9AIW	Franis, Lyle	Adams, Neb. (Partner of Howard Doole)	.5
9OY	Fritz, Jack A. S.	2211 Salisbury St., St. Louis, Mo.	.5
9AIX	Gabbert, Oscar F., Jr.	911 Kentucky St., Michigan City, Ind.	.5
9OK	Gerkey, Lewis K.	403 Lexington St., Independence, Mo.	1
9AJE	Gunderson, Clarence	1006 St. John St., Albert Lee, Minn.	.5
9PT	Howland, H. N.	Stony Island Ave. and 62d St., Chicago, Ill.	1
9RV	Huffman, Charles	131 W. Calendar Ave., La Grange, Ill.	.5
9AIP	Hunt, Clayton S.	R. F. D. No. 2, Urbana, Ill.	.5
9PT	Hyde Park High School Radio Club	(License in name of H. N. Howland) (Stony Island Ave. and 62d St., Chicago, Ill.	1
9OC	Johnson, Lorin F.	R F. D. No. 7, Columbia, Mo.	.5
9QU	Johnson, Paul E.	2800 E. 26th St., Minneapolis, Minn	.5
9AJG	Kansier, Victor H.	445 3d St., Reedsburg, Wis.	.5
9QB	Kees, Rossman, W.	1742 N. Park Ave., Chicago, Ill.	.5
9AJI	Kuhl, S. Harris	2508 N. Spaulding Ave. Chicago, Ill.	.5
9PV	Laube, Herbert L.	315 Grace St., Dubuque, Iowa.	.5
9NQ	Leininger, Clarence W.	2119 N. Tripp Ave., Chicago, Ill.	.5
9AAQ	Lewis, Hubert	5100 Easton Ave., St. Louis, Mo.	1
9PO	May, Howard L.	Buckingham Annex, St. Louis, Mo.	.5
9AIR	McCune, George H.	1445 N. Edward St., Decatur, Ill.	.5
9MC	Michaels, John J.	1352 Komensky St., Chicago, Ill.	.5
9AIZ	Miller, Carmi E.	217-219 E. St. Paul St., Spring Valley, Ill.	.5
9AJD	Morton, Clyde E.	341 S. Lawn Ave., Kansas City, Mo	1
9OL	Plank, George A., Jr.	101 N. Pleasant St., Independence, Mo.	1
9OG	Nestlerode, Boyd W.	701 Pierce St., Sioux City, Iowa.	1
9AJN	Schoenwolf, Fred L. H.	1917 Warner Ave., Chicago, Ill.	.5
9AIT	Smith, Nathaniel C.	912 N. Glen Oak Ave., Peoria, Ill.	.5
9ON	Thielens, Wagner P.	Y. M. C. A. Bldg., South Bend, Ind.	1
9FF	Wilkerson, Wilbur P.	1424 N. 29th St., Kansas City, Kan.	1
9AIU	Wolff, Jerome E.	510 W. Iowa St., Urbana, Ill.	.5

(To be Continued)

BARON MUNCHHAUSEN'S NEW SCIENTIFIC ADVENTURES.

(*Continued from page 725*)

are of course treated in a similar manner, as are all public places where Martians frequent. In fact anything that is handled by more than one person, such as tools, machines, conveyances, etc., everything is subjected to the germ killing treatment; the Martians never take chances of allowing diseases to be transmitted. It is an admirable custom and one well worth imitating on earth.

Our inspection of the Martian public health "bath" terminated, one of our two companions sharply looked at the top of one of the tall structures, on which were stationed a number of flyers. He closed his eyes for a second and almost immediately one of the flyers had swooped down alongside of us. Our companion had "hailed" the flyer by *thought transference*, the same as you whistle for a taxi on earth.

This flyer, similar in nature to the one we had used before in company with the Planet Governor, but much smaller, rose at once like a rocket, the minute we had boarded it. It made off in a southwesterly direction at a tremendous speed, and as we flew along Flitternix as well as myself suddenly became aware of a curious change in the air we were breathing.

I have already mentioned the fact to you that the Martian air is rich in *ozone*, and altho much thinner than the terrestrial air, it is far easier to inhale. Similarly I told you some time ago the Martian atmosphere reminds one of the air you breathe in a pine forest on earth.

As we progrest in our flight the air seemed to become much denser and stronger, and upon signaling this to one of our companions, he silently pointed to an immense conglomeration of structures which we were approaching rapidly.

Both of our companions during the next few minutes tried to explain the matter to us, and I think that by the time we finally landed at the immense plant we understood in a fair manner what this latest wonder consisted of.

To explain: On earth the atmosphere consists of, roughly, 20 parts oxygen and 79 parts nitrogen. Mixed with those gases are certain others such as carbonic acid gas, Helium, Argon, Krypton and Xenon. Another important part of the terrestrial atmosphere is water vapor, which latter varies from as much as 5 per cent to nothing, depending upon the temperature and locality.

Now on earth all animal life gives up poisonous carbonic acid gas and takes up the oxygen from the air. Furthermore, the total available atmosphere is slowly becoming smaller and smaller through the ages, by absorption into the earth as well as by loss into space. Consequently, if the atmosphere were not automatically purified all of the time of the poisonous carbonic acid gas, no animal life could be supported on earth in an appreciable time. Luckily for you, however, living plants absorb the carbonic acid gas and give up oxygen to it; furthermore, it has been calculated that any excess of ammonia and carbonic acid gas in the terrestrial atmosphere would be completely absorbed by the oceans, even if there were no plants. Thus at least for the present you need not be worried greatly that one nice morning the entire terrestrial population will find itself asphyxiated due to lack of air. On Mars, however, conditions are vastly different. To begin with, Mars is a much smaller body than the earth. Consequently, its gravitational attraction is but a fraction of that of the earth. For that reason the Martian atmosphere is not held down to the planet as securely as is the case on earth. Given relatively the same amount of air on Mars as on earth, it is easy to prove that Mars will lose an equal amount of atmosphere into space ten times quicker than does the earth.

This loss may not be more than 100 cubic feet a day (tho it is probably a great deal more), but in the course of several million years—which is but a short time in the life of a planet—the atmosphere will be seriously reduced.

Mars being a much older planet than the earth, it follows that its supply of air must be near the vanishing point, which in fact it is. Moreover there are no oceans on Mars to-day and no great forests, nor abundant plant life to purify the air from carbonic acid gas.

Just the same we are not complaining for a lack of air just yet, and as far as I can see, the Martians will sooner die from lack of water than from lack of air. A race that is intelligent enough to tap the planet's poles for its water supply, and to build waterways which carry this water from one side of the globe to the other, must be sufficiently intelligent to wrestle with Nature for its air supply.

And this the Martians actually accomplish. Not only do they manufacture their own atmosphere, but they keep it clean besides, ridding it of all poisonous gases from day to day.

Scattered over the planet's surface and spaced apart at equal distances, the Martians have erected sixty atmospheric plants, which generate the oxygen and nitrogen and a gas called *Toslon*. This latter, a gas similar to ozone, gives the Martian air its peculiar invigorating pine-needle smell.

The generation of the oxygen and nitrogen is almost entirely Tos-chemical. On Mars, however, the Tos-currents act entirely different from your electric currents, the Martian currents being inter-atomic, and for that reason infinitely more economical in their action, besides being tremendously more powerful.

Our flyer had now come to within several hundred yards of one of these wonderful air plants, and circling around it, we could see how tremendous its size and how miraculous the minds that built it.

For miles and miles we saw huge metallic spheres, each some 600 feet in diameter. These spheres were supported by monstrous towers, while the spheres themselves rotated around their axis rapidly. The axis, moreover, was hollow at each end, and its opening discharged into high flaring funnel-like contrivances.

Every two and one half hours the spheres stopped revolving and through a stationary shute, the necessary chemicals would be shot into the interior. Immediately the huge globe would start spinning anew while powerful Tos rays played upon each side of the sphere. These rays, by direct contact through the metallic body of the sphere, produced the oxygen or the nitrogen, it being understood that those spheres generating oxygen were charged with different chemicals than the ones generating nitrogen.

The two gases, by the centrifugal force of the rotating spheres are then shot out thru the funnels into the surrounding atmosphere and intermingle with it here. The surprising part was that the plant, huge as it was, was almost noiseless. The materials in the spheres were of course liquid, and the propelling mechanism was of the usual Martian atomic design and for that reason noiseless.

Another thing at which we marvelled was the small number of attendants in charge of the plant. Everything seemed to work entirely automatic and with an astonishing precision. The entire colossal plant, as was explained to us later, was in charge of only 60 Martians. And these attendants did not walk about, but were sent along on aerial wires, from one sphere to another.

Even the chemicals used were mined and mixed almost entirely automatically, but of this I will speak at another time. After mixing to a fluid state the liquids were conveyed automatically to huge reservoirs from which large distributing mains conveyed them to the final destination—the rotating spheres.

These wonderful plants work uninterruptedly day and night, each one of them supplying the Martian atmosphere with millions of cubic yards of air every day.

On our return to the "city" we made a detour and visited one of the numerous air purifying plants.

From what I understand there are several hundred of these plants in existence, all of them scattered equidistantly over the planet.

These plants are as simple as they are unique. Each plant has several million yards of a certain metallic wire cloth suspended several feet over the surface of the ground. This wire netting is about 2,000 feet high and really forms a huge wire cube, the sides of which are about 2,000 feet long. The netting is held in place by towers spaced equal distances apart and the top and bottom of the wire-netting cube are closed. In other words, we have a metallic wire-cloth cube 2,000 feet long by 2,000 feet high by 2,000 feet wide.

The netting is charged with a Tos current to such a high tension that the entire netting glows with a purple light, which is especially startling at night.

As the air moves on Mars, as it does on most planets that have an atmosphere, due to the heat of the sun, the air will flow thru the wire neting also. Now it is the function of the Tos currents in the netting to destroy the carbonic acid gas and the latter is precipitated in a chemical compound when it falls down in receptacles underneath the wire bottom. It is collected here and is used over again for special agricultural requirements.

These atmospheric cleaning plants are erected in sufficient numbers over the face of the planet in such an ingenious manner that ALL of the air must flow sooner or later thru one of the wire cubes, here to be purified.

Thus does Martian intelligence safeguard the planet's air supply. How long will it be with your coal burning machinery till the earth's atmosphere will need cleaning plants?

(*To be continued*)

A NEW CIRCUIT FOR UNDAMPED WAVE SIGNAL RECEPTION.

(*Continued from page 737*)

tho good results can be had with the latter, if baked out, and the winding treated with a good insulating varnish But, it is very hard to get all moisture out of fabrics, and after varnish is applied, it then becomes impossible for moisture to be gotten out. I know that there are those who think enameled wire has a sort of false capacity, but I have found it very satisfactory.

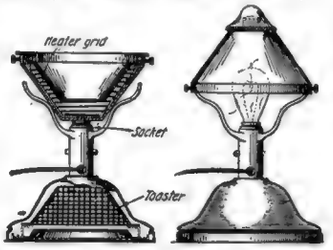
Third: Use a good incandescent lamp detector. Fourth: Use a porcelain base rheostat. Fifth: Use a 6-volt, 60 A.H. storage battery, to light the filament; altho dry cells will do. Sixth: For the 'phone circuit, use from 10 to 12 of the ordinary 3-cell flashlight batteries. Use a 1 M. F. Condenser, across the batteries, to keep the voltage steady, and as a by-path for 'phone circuit current. Seventh: The variable high resistance in the high voltage circuit is of carbon, and very much more satisfactory than taps on the batteries. Eighth: The polarity of the Aerial and Ground, and the connections to Secondary, must be reversed until the right combination has been arrived at; as it works only in one polarity.

LATEST PATENTS

Combination Electric Lamp and Stove

(No. 1,205,380; issued to Norman G. Nicoll.)

A clever invention, combining, in a very compact manner, a portable electric lamp and cooking outfit. The lamp shade contains an electric heating element, and when inverted and screwed into the lamp socket, it enables one to heat up



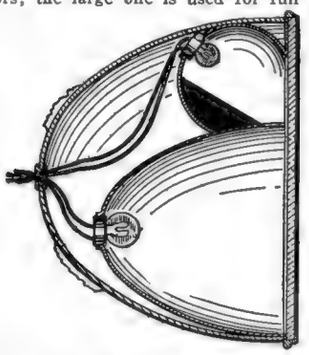
anything desired, such as water, milk, etc.

The hollow base contains a toaster, a receptacle and a grill. These may be removed from the base and fitted within the inverted shade when it is utilized as a heater or stove. The toaster consists of a basket of reticulated material of the same shape as the shade.

Auto Head Light

(No. 1,206,844; issued to Harry Jeffers Hoag.)

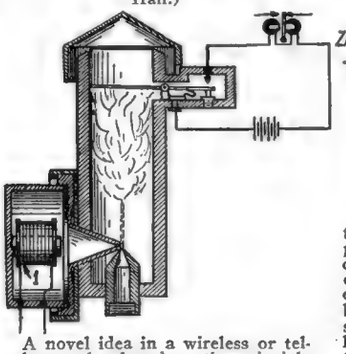
A new idea in electric automobile head lamps involving the use of two specially designed reflectors; the large one is used for full



illumination, when running on dark roads, etc., and the small upper reflector for city running. The upper reflector has its lower inner part blackened so that no blinding rays can be projected straight ahead, and also the top of this reflector bends downward at the front as seen. Thus, the illumination from the head lamps can be controlled for city or suburban running.

Wireless Relay

(No. 1,205,530; issued to Ray E. Hall.)



A novel idea in a wireless or telephone relay based on the principle that slight sound waves may be caused to exert a considerable variation on a jet, of either gaseous or liquid form, which is supplied under pressure from a nozzle placed at the base of the apparatus, as seen.

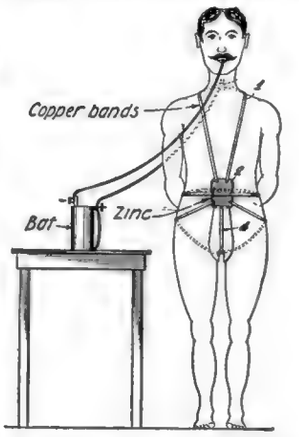
At the top of the jet chamber is a pivoted vane having a circular perforation at its center.

An incoming radio signal causes, by acoustic reaction, a spreading of the jet, and, in consequence, a resultant upward pressure to be exerted against the vane which opens the external circuit, momentarily.

Electrical Treatment Apparatus

(No. 1,207,614; issued to Wilson A. Olds.)

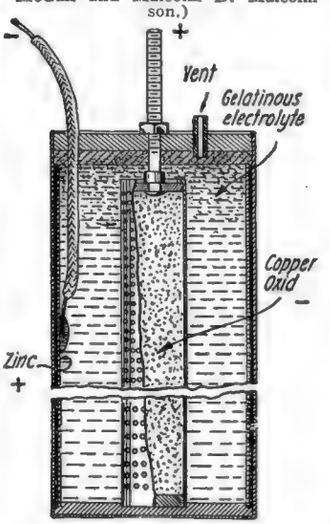
A method of applying galvanic current to the body by means of (virgin) copper strips or bands ar-



ranged to pass over the nerve centers and the trunk nerves of the body. These copper bands are connected at a common point, as seen, and also to a common source of electrical energy such as a primary battery.

Galvanic Battery

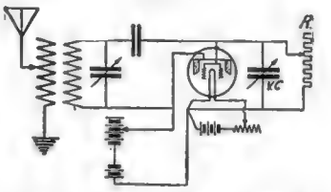
(No. 1,201,481; issued to Edward McGall and Malcolm D. Malcolmson.)



A unique form of galvanic battery employing an outer zinc or positive electrode and an inner, copper oxid negative electrode, both caused to react in a gelatinous electrolyte. The electrolyte may be formed by combining a heated solution of caustic soda or sodium hydroxid, the density of this solution depending upon the size and capacity of the cell, and a heated solution of either one, or a combination of, such materials as tapioca, wheat and other grains, gelatin, gums, potato and similar starch cells, and then cooling the mixture, whereby a gelatinous colloidal solution will be obtained.

Oscillating Current Audion

(No. 1,201,270; issued to Lee de Forest.)



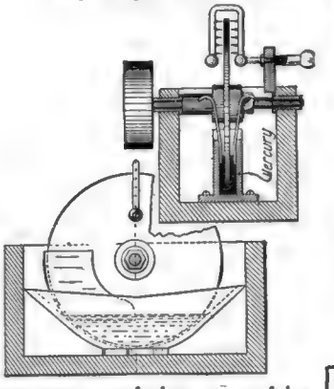
The Audion is connected with a coupling transformer to the aerial and ground as usual. The grid and one high voltage battery terminal are shunted by a non-inductive resistance and a variable capacity in the manner shown.

The inventor claims that by such means he has found it possible to produce large quantities of radio frequency energy, suitable for radio-telephonic transmission or for other purposes.

Static Generator

(No. 1,202,672; issued to William H. Chapman.)

A very simple form of static



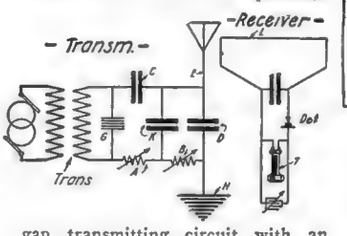
generator employing a revolving disk of glass or hard rubber, the lower part of which dips in a mercury trough. A fine, toothed collector is placed at the top of the machine so as to gather the static charge from either side on the revolving plate.

Use is made of two induction plates which dip into the mercury on either side of the revolving disk, which help to bind the charge developed on the surface of the revolving disk by its passage thru the mercury, and to prevent it discharging back to the ground thru the mercury.

Radio System

(No. 1,206,911; issued to Greenleaf W. Pickard.)

Involves the use of a quenched

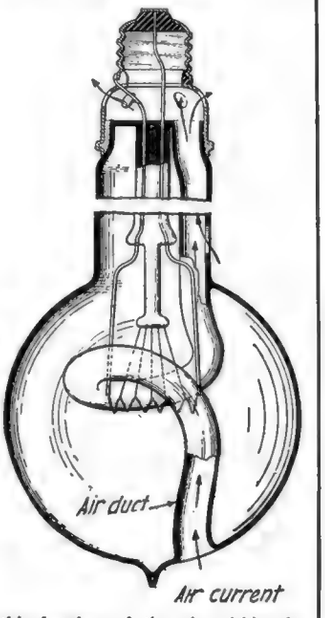


gap transmitting circuit with an oscillation-producing circuit—A, G, C, K; an energy-storage circuit—K, B, D, and a radiation circuit—E, D, H. The reservoir circuit—K, B, D, for instance, may have a wave length of 422 meters the same as the radiated waves, while the radiator circuit—E, D, H, may have a natural period of 250 meters. Gross efficiency reaches 80 per cent.

Ventilated Incandescent Lamp

(No. 1,204,653; issued to John H. Dale.)

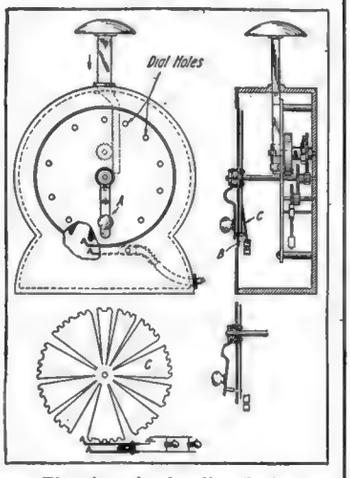
The heated air within the tube will tend to rise and pass out thru perforations in the metal base of the lamp, as becomes evident; also,



this heating of the air within the ventilated duct will not only cause it to rise, but will also cause an air current to pass thru the duct.

Electric Signaling Device

(No. 1,200,038; issued to Frederick O. Singer.)



Electric code signaling device embodying a revolving toothed disk, as shown. The movable blade (A) on the front of the instrument may be rotated and the pin (B) inserted in any desired code number opening. The tension of the spring normally causes it to press the certain sector of the disk inward so that when the disk rotates, it will intermittently close the two electrical contact springs and ring a bell, etc.

COPIES OF ANY OF THE ABOVE PATENTS SUPPLIED AT 10c. EACH

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A. F. LIVVER OF LIVERANBAKON, U. E.

PEDOMOBILE

Specifilication Ossified **Patent Supplied**

TO WHOM IT MITE CONSARN:

Be it known to all Presents, Gifts and Donations residing, in, on above, below or otherwise in these U.S.A., as well as all other citizens, dogs and codfishes, that I, Alphonsus F. Livver of the Ham-let of Liveranbakon, in the county of R.F.D. in the State of Utter Exhaustion, have perfected, originated as well as otherwise invented a novel as well as extremely useful means of locomotion for bipeds as well as all other *Homo Sapienses.*

In these days of rapid locomotion, by mechanical means, even Hennery Phord seems to have overlooked the fact that on this planet lies dormant a vast and unthinkably large energy which needs only to be touched with a magic wand in order to blaze forth in all its glory.

When I say "lies dormant" I do not speak really literally. I should have said "walks dormant."

The vast and unthinkably large energy to which I refer is the lower extremities of the species *Homo Sapiens,* otherwise known as hoofs and shins.

In moving over *terra firma* it is calculated that in the U. S. alone some 69,637,789 Horse Power goes to waste each day, by man's lower limbs, that is by those humans that don't own flivvers.

Years ago an unsuxessfull experiment was tried on mankind for several years in order to reduce this abominable waste. I refer to the bicycle, which however proved a failure because you had to push down and sideways, thereby taksing your strength to the utmost.

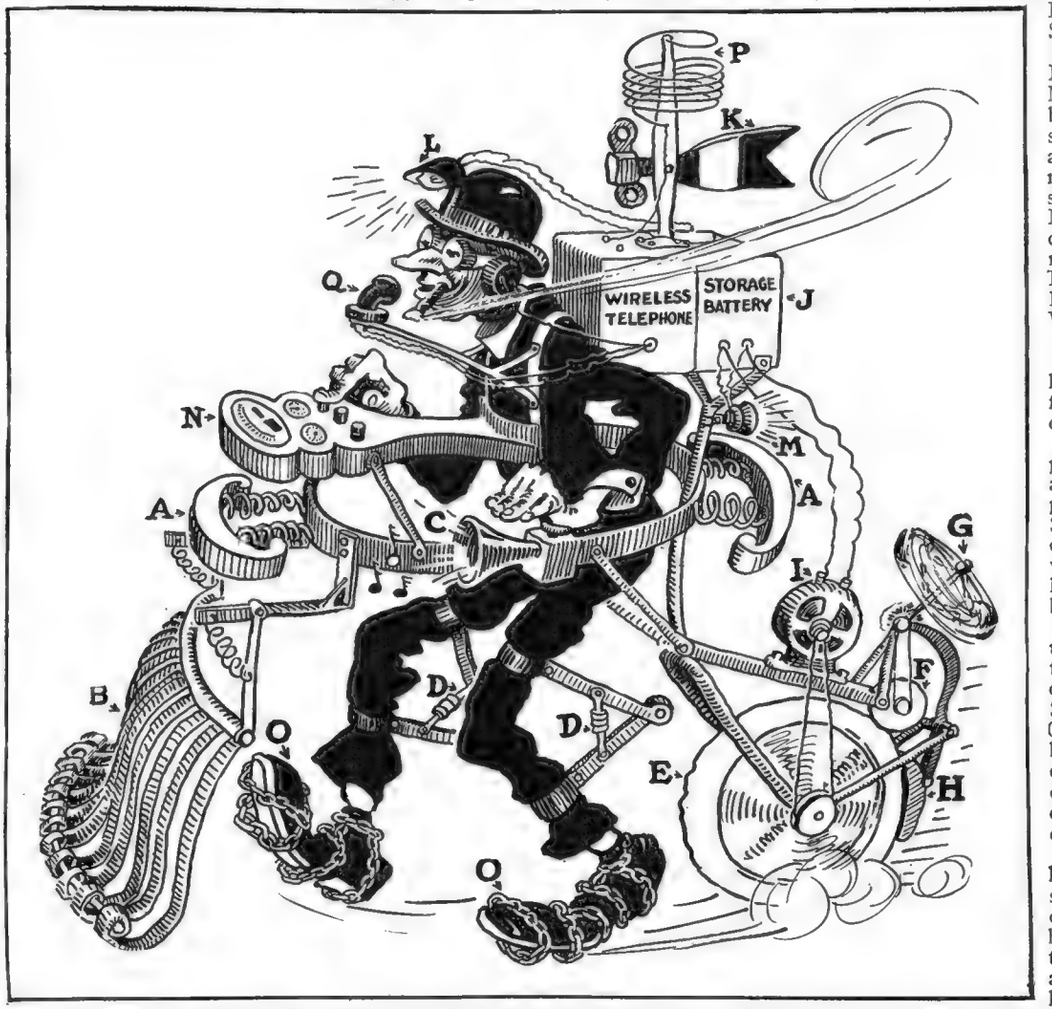
What is needed is a machine which does not impair the natural ingrown walk of man, and only such a machine will succeed in resurrecting mankind.

From the patent drawings and specifilications accompanying this applification it will be observed that my new Pedomobil can be used by anyone without practice. It will run at practically any speed, there being no limit except the rider's wind. It is exceedingly cheap to construct, it is in fact the car for the masses. No gasoline or other fuel is required to drive it; having only one tire, its cost of upkeep is reduced to practically nil.

It can be steered with one hand if necessary, while wobbly early-morning returners, will find great comfort in owning such a car, by reason that it will "uphold" the most skittish driver.

Attention is directed to the governor which controls the brake. The adjustment being locked by the Interstate Commerce Commission, overspeeding is practically impossible. Hence accidents are reduced to less than ¼% of the total.

Referring to drawing the following will make everything clear: A, Spring Bumpers; B, Fender; C, Warning Signal; D, Shock Absorbers; E, Rear Trailer; F, Friction Gear for; G, Governor which controls; H, brake; I, Generator; J, Storage Battery; K, Semaphore; L, Headlight; M, Taillight; N, Switchboard with speedometer, ammeter, voltmeter and switches; O, Non skid chains; P, Spiral Aerial; Q, Transmitter for Radiophone.



Mr. A. F. Liver, of Liveranbakon, U.E., here demonstrates the superfluous and superhuman ideas involved in his justly famous "Pedomobile"—the pleasure vehicle for the masses. The flivver that flivs without gas. It cannot skid, neither can it exceed the speed limit. It goes as long as its owner does.

WHAT I CLAIM IS:

1° A Fuelless flivver flivvering without gas.

2° A low-priced flivver approved and passed by the S.P.C.A. (Society for Prevention of Colliding Automobiles).

3° A pleasure vehicle for the masses requiring neither Shoffor nor Garash. Can be instantly changed from open to closed car by means of umbrella.

In witness I have thus spilled my indelible phiz herewith and thereunder for all times and hereafter and next friday, as well as thereafter, so help me all good flivverers, unto eternity, Amen.

A. F. LIVVER

By his Attorney

Thomas William Benson

Philadelphia, Pa.

Wittynesses:

Ham Enegs

Kerro Sene

Levi Tation

QUESTION BOX

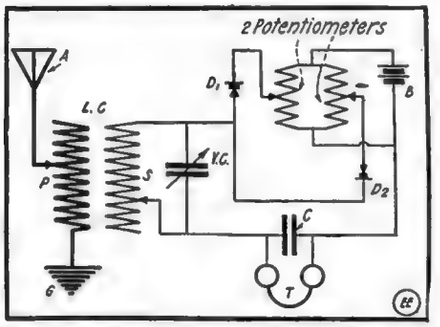
This department is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., **must** be on separate sheets. Questions address to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

RADIO QUERIES.

(695.) H. Pearson, Sante Fe, N.M., wants

Q. 1. A wiring diagram of a double opposed crystal detector system so as to help eliminate interference.



Hook-Up for Double "Opposed" Crystal Detector Scheme as Used by the Marconi Company.

A. 1. The diagram herewith gives the connections. In operating such an arrangement, care should be exercised to see that one detector is slightly detuned. This is very important if the most satisfactory results are desired. The 'phones are shunted across a low capacity condenser.

Q. 2. Would two like detectors do for this kind of work; say two silicon or galena detectors?

A. 2. Two unlike detectors are preferable; especially those which are controlled by potentiometer and battery, such as carborundum and perikon detectors. It has been found that excellent results are obtained from a combination of carborundum and perikon detectors connected as indicated.

Q. 3. What type of detector is used on ship-board?

A. 3. There are several types of detectors used thus, depending upon the system of apparatus the ship is employing. The Marconi Wireless Telegraph Company installs on its ships either a carborundum detector or a Fleming valve; the Telefunken sets use galena, the Wireless Specialty Apparatus Company, which supplies the U.S. Government with receiving instruments, uses the perikon. The above mentioned detectors are the most popular for commercial uses.

WATER MOTORS.

(696.) Paul Jebson, Canton, Ohio, inquires:—

Q. 1. Upon what does the horse-power of a water motor depend?

A. 1. The H.P. of a water motor depends upon several factors, the diameter of the rotor, the size and number of buckets, and the pressure of the water. The greater the pressure, the greater the power developd by the water motor. It is customary where the water pressure is low to increase the size of the rotor, thus obtaining the required amount of power.

Q. 2. Is it permissible to employ high water pressure in the city for running such motors?

A. 2. As far as we know there is no law prohibiting the use of high pressure for running water motors. It is extremely difficult as a rule to obtain high pressures in cities as the water consumption is so great that the pressure is necessarily quite low in most cases.

TO OUR FRIENDS.

Do you realize that not one day passes when we do not receive from 150 to 250 or more letters addrest to the "Question Box"? If we were to publish all the questions and their answers we would require a monthly magazine five or six times the size of The Electrical Experimenter with no other matter but questions and answers! Of late the influx of letters has become so heavy that several of our associates have been forced to discontinue important editorial work, in order to answer the mail. This we are certain you do not wish. You do not want your magazine to lower its present high standard. You want the best, the very best, and you know we never have failed you yet.

Moreover the multitude of letters are wholly unnecessary. Most of the questions we are asked every day have been answered before in the Question Box. Therefore ere you sit down to write to us, look over your back numbers and nine times out of ten you will find the answer.

We strive hard to publish only such matter as has not appeared before in our columns, and for that reason only a small fraction of queries of those received by us are actually publisht.

Kindly note, therefore, that in the future we cannot, in your own interest, answer questions by mail, free of charge.

For questions requiring immediate answer our fee is 25c. for the first ordinary question and 25c. for each additional question. We will gladly advise fee for special questions entailing considerable calculations or research. Stamped and addrest envelope should be enclosed with the queries and, moreover, any sketches accompanying them should be made on separate sheets. And please be brief.

THE EDITORS.

Q. 3. Where can I obtain full information regarding water wheel design, construction and installation?

A. 3. We refer you to the July and August, 1916, issues of THE ELECTRICAL EXPERIMENTER, in which you will find complete data on the design of water wheels for any horse-power.

INSTRUMENT SHUNTS.

(697.) David Wolf, Kalamazoo, Mich., writes:

Q. 1. How are shunt ammeters arranged to correctly measure the current?

A. 1. The instrument coil is arranged so that a definite proportion of the whole current passes thru it. A large conductor of low resistance is connected directly between the two terminals or binding posts of the instrument; the coil is connected as a shunt around a definite part of this main conductor; then, since the two are connected in parallel and each branch has a definite resistance, the current divides between the two branches, directly in proportion to their relative conductivities, or inversely according to their resistances. The coil, therefore, takes a definite part of the whole current and the force moving it and its pointer away from the zero position is directly proportional to the whole current. Hence, by providing a proper scale, the value of the entire current will be indicated.

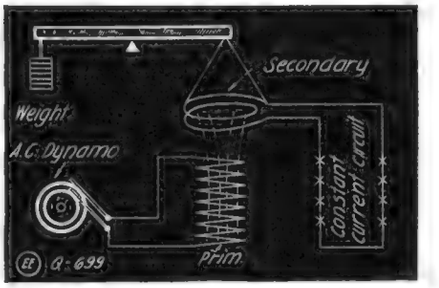
Q. 2. How is a voltmeter connected?

A. 2. A voltmeter is invariably connected to the two points whose difference of potential is to be measured. Voltmeters to measure several thousand volts A.C. are usually connected to the low tension secondary of a step-down transformer whose primary is wound for the high tension line potential.

CONSTANT CURRENT TRANSFORMERS.

(699.) Charles Maxwell, Erie, Pa., wishes to know the principle of the constant current transformer and also a diagrammatic illustration of its component parts.

A. 1. The principle of the constant current transformer as used for series arc, and incandescent lighting is readily understood by reference to the elementary diagram shown. A constant potential alternating current is supplied to the stationary primary coil, which induces a current in the movable secondary coil. The pressure induced in the coil will depend on the number of lines of flux which pass thru it and by changing its position in the magnetic field over the primary a variable E.M.F. can be produced and a constant current maintained in the lighting circuit when the

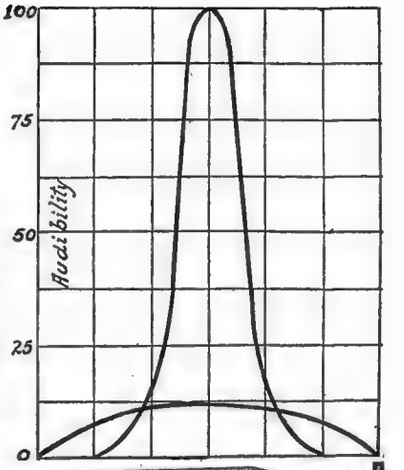


Circuits of Constant Current A. C. Self-regulating Transformer for Arc or Incandescent Lights.

lamps are turned on or off, or if the resistance of the circuit be lowered by the

(*Continued on page 756*)

NOTE THAT PEAK



THE peak is what you get on a RA-6 regenerative receiving set—100 times amplification. The lower curve is the response you get on an ordinary set.

Just imagine the amplification—100 times—and the selectivity is just as great as the amplification. No damping in that peak signal, no interference even if that other station is on the same wave. When you get that peak, you are getting all there is to get out of any incoming signal.

How many times have you had a signal fade out, and tried everything under the sun to hold it just a second or two longer? Then study that peak. Note the difference—see all the strength of signal you have to spare over the strength of signals over an ordinary set.

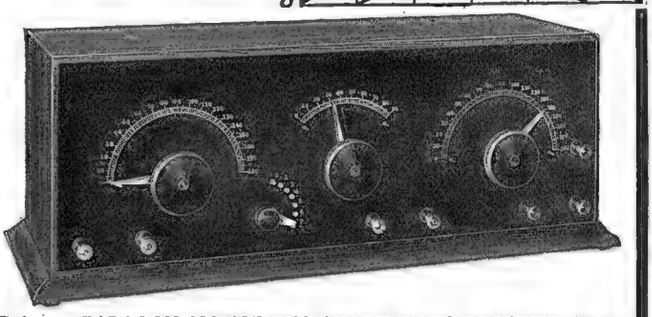
How about the stations you have never heard? Stop worrying because the fellow with the big aerial hears them and you don't. That peak will bring them in. The RA-6 will give you that peak.

This instrument is super-efficient, super-selective and super-sensitive. It was designed especially and solely for reception of **AMATEUR-WAVE LENGTHS** and its development has been carried on over a period of two years. It was the FIRST and is the ONLY worthy adaptation of the Regenerative circuits to short-wave reception. The antenna inductance is arranged in steps. **ASIDE FROM THIS THERE ARE NO SWITCHES.** Continuously variable inductances—carefully designed variometers are used in the closed circuits. **HIGH RESISTANCE CONTACTS, the capacity of switch points and leads, end-turn losses and the necessity for a variable tuning capacity are thus ENTIRELY DONE AWAY WITH.**

The antenna and closed circuits are INDUCTIVELY COUPLED and the COUPLING IS VARIABLE. The component parts of the instrument are not crowded into a small cabinet. The fact that ALL of these things are of extreme importance has been proven by the here-to-fore unheard-of **SELECTIVITY** and **AMPLIFICATION** obtained by owners of this instrument. Signals may be read from stations at extreme distances or through heavy static and interference with this instrument long after other receivers have failed, and WEAK SIGNALS MAY BE AMPLIFIED UP TO **ONE HUNDRED TIMES USING ONE AUDION ONLY.**

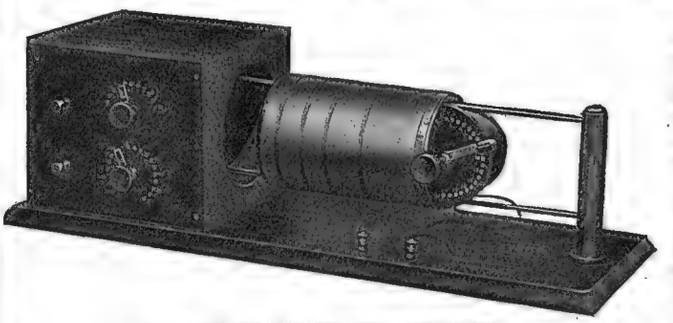
The RA-6, price $35, is as perfect mechanically as it is electrically. It is made right. Everything used in it is the result of long trial and experiment, to make a short-wave set that would give the greatest possible response to any incoming signal, on 180 to 580 meters.

Make that peak work for you ***now.*** Write us ***now.***



R.A.—6—PARAGON AMPLIFYING SHORT-WAVE RECEIVER, $35.00
Range 180 to 580 Meters

PARAGON WIDE RANGE RECEIVING TRANSFORMERS



PARAGON RECEIVING TRANSFORMER
TYPE "L" $22.50 TYPE "S" $30.00 TYPE "X" $35.00

The methods employed in winding the coils eliminate leakage due to coloring matter in the insulation, put an end to the presence of moisture in the varnish, insulation and tube. The coils of the Paragon **"No-End-Loss"** transformers are divided into sections and fitted with **self-cleaning, positive-action** end-turn switches which connect and disconnect the winding as required, **entirely cutting off from the circuit** unused portions of the inductance and **completely eliminating end-turn effects on all wave lengths.** These switches are enclosed and are automatically controlled by the primary and secondary inductance switches respectively.

Panels, housings, switch heads, etc., are of polished black FORMICA, which is superior in every way to hard rubber and costs more. All metal parts are of gold lacquered brass. These instruments are adapted to extremely close tuning and due to the absence of end-losses are particularly recommended as the only receiving transformers on the market suited to the reception of amateur wavelengths or for use in conjunction with the AUDION-DETECTOR.

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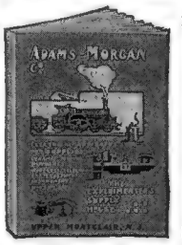

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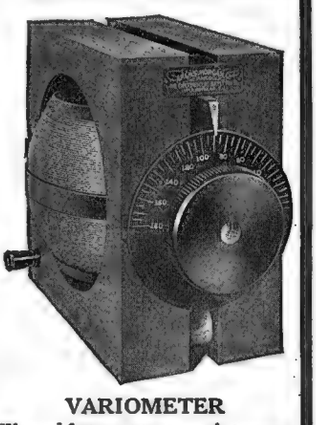

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Adams-Morgan Co., 13 Alvin Place Upper Montclair, N. J.

QUESTION BOX.

(*Continued from page 754*)

consumption of the carbons, as is usual.

Since the induced currents in the secondary are repelled by the primary leakage flux, there is a tendency for the secondary coil to move out of the primary field, and in case of a very large current due to a short circuit in the lamp circuit, the secondary current is quickly reduced to normal by the rapid movement of the coil upward.

By adjusting the counterweight for a given number of amperes required by the arcs the current will be maintained constant by the movement of the secondary coil. The magnetic field produced by the primary must be kept the same by a constant current from the alternator. Therefore, when the lamp load is increased the secondary voltage increases so as to maintain the secondary or lamp current constant. In other words, the alternator and automatically regulating transformer supply a constant current at variable voltage, each arc requiring about 6 amperes and 70 volts. The secondary E.M.F. may therefore easily amount to 2,000 volts or more with a number of arcs in use.

Constant current incandescent lighting systems for use in small towns also employ this method for automatically regulating current.

ANTENNA QUERY.

(700.) W. R. Milner, Mooresville, Ind., asks the following:

Q. 1. Would it be advisable to use zinc coated telephone wire for an aerial?

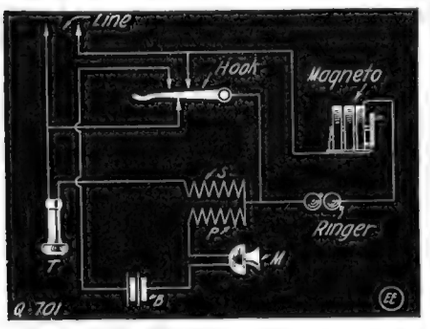
A. 1. There is no objection to employing a zinc coated telephone wire for the construction of the antenna.

Q. 2. Would a No. 12 telephone wire be as satisfactory for a lead-in from the aerial to instruments as an *Antenium* wire, of which the antenna is constructed?

A. 2. Telephone wire is satisfactory to construct the lead-in from the aerial. For the ground lead you should use No. 4 Antenium conductor as the amount of current radiated to the ground is maximum, while the potential is a maximum at the top of the aerial.

TELEPHONE DIAGRAM.

(701.) John Logan, Chicago, Ill., writes:



Hook-Up of Common Subscriber's Telephone Instrument, with Calling Magneto and Bell.

Q. 1. Give me a diagram of a simple subscriber's telephone outfit including magneto generator for ringing use.

A. 1. The diagram herewith gives desired information.

Q. 2. He also wishes to know where he can obtain an amplifier.

A. 2. We would refer you to the advertising columns of THE ELECTRICAL EXPERIMENTER, in which you will find listed numerous companies supplying amplifiers for both radio and telephonic uses.

(*Continued on page 758*)

ALTERNATING CURRENT ELECTRICITY AND ITS APPLICATIONS TO INDUSTRY. Second course. By W. H. Timbie and H. H. Higbie. Cloth covers. Size, 5¼ by 8 inches; 729 pages; 297 illustrations. 1916. Price, $3.00 net. Publisht by John Wiley & Sons, New York City, N.Y.

The second part of a most valuable work by these eminent writers is here presented. It covers a very large number of practical problems in a thorough scientific manner so that the average electrical student can readily master the principles involved and set forth.

The first chapter takes up the alternating current generator and its critical consideration as a power station unit. Various factors such as the efficiency, causes of voltage variation, automatic voltage regulation by Tirrill regulators, excitation, power factor and load capacity, short-circuit effects, etc., are carefully and thoroly discust.

Then come sections on parallel operation of Alternators, Transformers—their efficiency, regulation and connection on polyphase circuits, Feeder voltage regulators, Constant current transformers, Auto-transformers, A.C. Transmission lines of all sizes and the necessary calculations for capacitance, inductance, and resistance, use of lightning arresters of various types, Asynchronous motors, Synchronous motors, etc.

The section dealing with Converters and Rectifiers is one of the best the reviewer has yet seen. All of the leading types of converters and rectifiers are clearly discussed, including the vibrating rectifier (with oscillograms of its actual performance), the Electrolytic rectifier (with oscillograms), the Mercury-arc rectifier (with oscillograms), etc. Anyone not fully understanding the synchronous rectifier will indeed do well to read this book. Few, very few text-books on the all-important subject of alternating current engineering pay sufficient attention to the explanation of the rotary converter. Where does the direct current come from that our trolley cars use after the high tension A.C. transmission line has sent its quota of pulsating energy into a rotary converter sub-station? It is safe to say that the average electrician, or at least the student, has anything but a "foggy" idea as to where the direct current originates as it flows from the converter. By means of special diagrams this always hazy subject is cleared up in an understandable manner.

It is a worthy complementary volume to the "First Course" by the same authors and happily is written in such a manner as to prove extremely and equally valuable to the student, electrician and engineer.

THE ELECTRICAL CONTRACTOR. By Louis W. Moxey, Jr. Cloth covers; size 6x9¼ inches; 86 pages, illustrated. Numerous tables. Price, $1.50. Publisht by the McGraw-Hill Book Company, New York City, N.Y., 1916.

Mr. Moxey has provided us with what appears to be a most concise and valuable treatise for the use of electrical contractors. Knowing well that such men are invariably too busy to be bothered with minute and exact physical calculations for the design of lighting and motor circuits he has boiled down the gist of the matter to a few tables which anyone can use accurately.

The first part of the volume treats on cost of conducting a contracting business and methods of keeping costs figures by card file, etc. The standard methods of figuring the overhead cost, percentage of profit, unit cost of installing lamp, bell, annunciator and motor outlets are explained and examples given. Tables of costs for installing motor foundations, motors and their equipment, panel boards, wiring, etc., are included.

The wiring calculations cover three-wire D.C. systems; one, two and three-phase A.C. systems; calculation of voltage drop in overhead lines, etc. A chapter is given on illumination calculations, absorption of light by globes of various materials, etc. Data are given for conduit fittings, and underground construction. A slight typographical error appears on page 50 in regard to the panel board A in Fig. 10.

The book is well edited, strongly bound and should find a place in every electrical contractor's library.

A HISTORICAL INTRODUCTION TO MATHEMATICAL LITERATURE. By G. A. Miller, Professor of Mathematics at the University of Illinois. Cloth bound; size 5¼ by 7½ inches; 302 pages. Price, $1.60. Publisht by the Macmillan Company, New York City, N.Y.

In this interesting book by Professor Miller, there is given a much needed dissertation on the history of mathematics and the leading mathematicians of the world, since ancient times.

The matter is presented in such interesting form that it will appeal not only to students of mathematics, but to those lay readers who like to study this subject in a more or less general way.

Some of the most interesting features about this book are those involving the presentation and discussion of the somewhat uncommon as well as the more generally known mathematical problems which have been propounded from time to time in the world's history.

It is surprising, in looking over this work, to note the great variety of mathematical conundrums which have been proposed by various students of this subject and some of which still remain unsolved to this day. The laws governing the construction of some of our mathematical tables of the present day are explained in their historical aspect. The average reader of this book will surely learn many things which he undoubtedly did not know before regarding the vast amount of work involved in the solution of some of the simpler mathematical hypotheses.

Professor Miller's treatment of the subject is very broad in scope and covers such points as errors in mathematical works, the general divisions of mathematical literature and the critical method of stating algebraic and other problems. The chapters covering developments in geometry and algebra are particularly interesting. Also, the chapter treating of prominent deceased mathematicians, wherein the principal mathematical rules and ideas of the most prominent men in this branch of science are recorded.

A valuable appendix is given containing the names of important works on mathematics and the history of mathematics. Also, a list of books on Teaching and Philosophy. It is to be deplored that there are no illustrations, particularly of the well-known mathematicians whose life work is sketched in this otherwise admirable book.

STANDARD WIRING FOR ELECTRIC LIGHT AND POWER. By H. C. Cushing, Jr. Flexible covers, 6½x4¼ inches, profusely illustrated. Publisht by the author, New York City, N.Y. 22nd Edition, 1916. Price, $1.00.

The latest revised edition of the well-known standard wiring manual which is, perhaps, used by more electrical men, especially designers and those who do or the ones who have charge of the actual work, than any other similar work.

The aim of Mr. Cushing's book is to explain the various clauses in the Fire Underwriter's rules, which govern all electrical installations and to elaborate on these various clauses by means of special illustrations and examples, with the necessary wiring tables, etc., so that the practical electrician and designer can lay out in the proper manner suitable wiring installations for lamps, motors or other electrical devices.

Wiring plans are presented for the proper arrangement of all types of outlets in the various rooms, including even the cellar of an up-to-date dwelling. These show the arrangement of electrical apparatus for a master bedroom which is fitted with both interior and public telephones, an electrical ozonizer and other appurtenances such as a push button for bells in servants' quarters, master switches for lighting, etc. Both high and low potential systems are discust from the Underwriter's view-point and such matters as transformer installations and 3-wire systems are clearly explained.

Diagrams are given for the approved installation of series, shunt and compound wound motors and dynamos as well as the multiple connection of two dynamos and circuits for two dynamos used to supply a 3-wire system.

Many important and practical hints are given regarding the installation and maintenance of electric motors and dynamos of all sizes; also an explanation of the principal troubles encountered in their operation.

A method of calculating the proper size of conductors for various size motors and dynamos is presented together with the necessary formulae and tables. Computations as given for this work are about the simplest that have ever been brought out and have remained the standard for a number of years.

HOMAN'S FIRST PRINCIPLES OF ELECTRICITY. By J. E. Homan. Cloth bound; 248 pages; 7¾x5½ inches; illustrated. Sully and Kleinteich, New York City, N.Y. Price, $1.00. 1916.

The author has endeavored, in this popular volume on the elements of electricity, to cover as much ground as possible, apparently, and has succeeded in bringing out many interesting technical points in a popular way which will appeal particularly to students and others who know nothing in detail about electricity.

The various chapters cover the physical constants of electrical circuits, such as the definition and calculation of watts and horse-power, etc., also such valuable subjects as primary and storage batteries; series and multiple circuits; electromagnetic induction; magnetism and its laws; alternating currents and the difference between single,

(*Continued on page 758*)

GERMICIDAL VALUE OF THE ELECTRIC CURRENT IN LAUNDRY PRACTICE.

Many remarkable things have been accomplished in the application of electricity to scientific and industrial uses. In fact, the application of electricity has given us such a maze of impressive innovations that, in the argument of the sophist, there is nothing which may not be effected by its aid. It is only to be expected, therefore, that to the lay mind the word *electric* has come to be a word to conjure with, writes Mr. H. G. Elledge, of the Mellon Institute of Industrial Research in the *Electrical Review*.

Unfortunately, however, there have been advanced, from time to time, claims regarding the application of electricity which are untenable in the light of scientific knowledge.

One of these has come very forcibly to the attention of the writer of this note. This is the claim that by passing a current of electricity through water, sterilization of the water is accomplished and that the electric current passed through the water of a washing machine may be used to advantage in the laundering of soiled clothes.

The claim that a liquid can be sterilized by the passage of an electric current through it, is denied by every authoritative investigator whose work has been reported in the literature. An argument which, at first thought, would appear to refute this statement is the fact that many municipal water supplies and swimming pools are purified by electrical means. When this application is examined, however, we find that the bacterial count for the water in question is reduced by passing into it sodium hypochlorite which has been made by the electrolysis of salt solution. It is by the well-known action of sodium hypochlorite that the reduction of bacterial life is effected, and the result is accomplished just as effectively when this germicidal reagent is prepared by another method.

In order to confirm the evidence in the literature that the electric current is not germicidal, the following experiments were made in the laboratories of the Mellon Institute: Recognizing that chemicals of a strongly oxidizing action, or acid or alkaline reaction, are destructive to bacterial life, a salt was chosen for the electrolyte which would not, by electrolysis, produce a substance of this nature. The salt selected was sodium sulfate; 150 cubic centimeters of pure water in a 300-cubic-centimeter glass beaker were used with varying amounts of sodium sulfate. The platinum electrodes used had an area of two square centimeters and these were placed six centimeters apart. *B. Mycoides* were planted, mechanical agitation was provided, and then there was applied current that would pass through a 16-candlepower carbon lamp from a 110-volt, direct-current circuit. After a run of two hours the usual test showed no reduction in bacterial count.

Tests similar to that above mentioned, in which the current density was varied and platinum electrodes were changed to aluminum ones of greater area, showed, in no case, any observable bactericidal action.

The results of this series of tests are confirmed by the work of R. D. Scott, of the Ohio State Board of Health. (*Ohio Public Health Journal* (1916) Vol. 7, pages 32-4.) Hence it is concluded, in agreement with other investigators, that electric current of ordinary densities (that is, densities below which the resultant heating of the electrolyte would effect pasteurization) has no germicidal action.

Regarding the claim that the electric current, when passed through the water of a washing machine, may be used to advantage in the laundering of soiled clothes, consideration must be given to the fact that any possible advantages must be either in the germicidal action of the current *per se* or in some detergent substance formed by the electrolysis of the salts in the washing bath. The first possibility is, of course, eliminated by the experiments just described. Since those supporting the second claim mention the use of salt to produce chlorine bleach (for example, see United States Patent 1,059,071) the first test was to determine whether sodium hypochlorite would be produced by an arrangement of electrodes in either end of a washing machine. Aluminum electrodes, or electrodes of aluminum and lead alloys, were mentioned in the claims. Experience in electrochemistry indicates that, with electrodes so placed and current densities as suggested (one-half to one ampere), only a negligible amount of hypochlorite or available chlorine would be formed, even if electrodes of platinum, etc., or carbon were used. If other electrodes were used, a prior knowledge would indicate that no available chlorine would be formed, because the available oxidizing power would be spent on the anode.

It may be concluded that there is no advantage to be obtained by passing a current through the wash water of a clothes-washing machine. The electric current *per se* is not germicidal, although it may be utilized in the production of germicidal chemical compounds.

The electric "shoeing" machine for street cars now has an extensive use in many car repair shops. It is a machine which goes under a car, lifts up the trucks one at a time and grinds the noisy flat spots off the wheels without removing the car trucks—formerly an expensive and tedious process.

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Smooth Wound Wireless Tubes

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3	x 7½	.12	.18
3½	x 7½	.12	.18
4	x 7½	.15	.22
4½	x 7½	.20	.27
5	x 7½	.25	.31
5½	x 7½	.25	.33
6	x 7½	.30	.37

GENERAL INFORMATION

These prices include PARCEL POST CHARGES: and are shipped at once on receipt of order and remittance.

We CANNOT furnish these tubes in longer lengths than 7½" unless ordered in quantities of 100 of a size.

We CAN furnish SPIRAL WOUND TUBES in any length up to 45 inches at .02 per inch in the following inside diameters, 3½-4-4½-5-6.

BEETLE & MACLEAN MFG. CO.

21 BROMFIELD ST. BOSTON, MASS.

BOOK REVIEW.

(*Continued from page 756*)

two and three phase currents. The operating principles of the magneto and other dynamos is carefully explained with suitable diagrams and the practical features of electric motors such as the torque of a motor and its calculation in foot-pounds is expatiated upon, as well as the action of alternating current induction motors and transformers.

The text matter concludes with a useful appendix of tables giving the areas and circumferences of circles; telegraph codes, etc.

This book is unhesitatingly recommended to those who wish a popular exposition on the subject, yet one that will give them a fairly thoro knowledge of electrical apparatus in general.

HOMAN'S AUTOMOBILE HANDBOOK. By J. E. Homan. Cloth Bound; 248 pages; 7¾x5½ inches; 79 illustrations. Sully & Kleinteich, New York City, N.Y. Price, $1.00. 1916.

An excellent handbook by a well-known writer, on self-propelled vehicles, which contains sufficient discussion of the theoretical principles involved in the operation of modern multiple cylinder motor cars, to give a good understanding of the subject.

The various details of the Entz magnetic transmission system and its advantages for automobile drives are given, as well as the frictional transmission system.

The various methods of changing speeds by shifting gears are illustrated and described by means of special diagrams, which should make this work very easily understood by lay readers; particularly the average owner of an automobile who has but little time to read thru extensive as well as technical literature on the subject.

There are chapters on the adjustment of the ignition and also on the adjustment of the mixture supplied the engine cylinder thru the carbureter. They contain many valuable hints for the practical man who must know how to operate his own car.

A number of valuable points are cited concerning such matters as the water jackets and precautions to be taken against freezing of the jacket water. Several practical formulae are given for mixing anti-freeze solutions.

The calculation of horse-power developed by various types of gasoline engines is taken up, as well as the various advantages and disadvantages of single and multiple cylinder engines.

ELECTRICAL TABLES AND ENGINEERING DATA. By Henry Horstmann and Victor H. Tousley. Cloth bound; 332 pages; 6¾x4½ inches; 34 illustrations with 132 special tables. Francis J. Drake & Co., Chicago, Ill. Price, $1.00. 1916.

This ambitious pocket size volume, altho low in price, contains a surprisingly large amount of technical information in tabular form for electrical workers of all classes. It is a book which will be found useful by electrical draftsmen, engineers, electricians and all those who are actively interested in electrical work of any sort.

An excellent assortment of specially compiled tables is incorporated in the work which have never been published before. These cover subjects which the electrical man and designer will daily come in contact with, such as dimensions for electrical conduits and the sizes of wire which they will properly accommodate; sizes of copper bus-bar for switchboards; horse-power of belts; data on all kinds of flexible cord and other conductors as used in electric wiring for lamps, motors and heating appliance; tables showing the illumination in foot-candles from 25, 40 and 60 watt tungsten lamps, arranged in various forms and at different heights above the floor. Standard symbols as used in laying out wiring plans for buildings are given, as well as data on switches and switchboards, including sizes for various current capacities as approved by the Underwriter's rules, etc., etc.

Many other practical and very interesting subjects are treated in this out of the ordinary work, such as the measurement of high voltages by needle spark gaps; the use of the slide rule; methods of splicing ropes for rope drives and construction work; resuscitation from electric shocks; the installation of motor drive for various sizes of electrical refrigerating machines and other industrial apparatus; data on line construction with the allowable stresses on line poles projecting at various heights above the ground and the effect of sleet and wind, as well as the calculation and strength of guy cables and wires; besides a host of other miscellaneous allied information which makes this book unusually valuable and practical.

(*Continued on page 760*)

QUESTION BOX.

(*Continued from page 756*)

Q. 3. How many systems are there employed in telephone party line work?

A. 3. There are two systems extensively employed, the *bridging* system and the *series* system. The difference between the two is that in the bridging system, the magneto and the polarized bell are shunted across the main line and an automatic device is attached to the shaft of the generator which when revolved at proper speed connects the magneto alone with the line, calling the party on the opposite end. At rest, this automatic device closes, thus leaving the bells across the line. All of the various stations are shunted across the line.

In the series system, however, the magneto and bell are connected in series with the main line (as well as all stations) and are made of low resistance and the complete circuit of these two instruments has a low impedance, thus permitting the talking current to flow thru them when they are at rest. To ring a party one must energize all the series connected bells on the system; the chief defect of the series system is that the talking current must pass thru all the bells in the system with a consequent loss of power.

There is also a third system which is called the harmonic or biased bell system. In the harmonic system the ringing is performed by means of frequency changing apparatus. Another system utilizes positive and negative impulses on different lines with special bells.

RADIO ENGINEER.

(702.) Louis Tracy, Beverly, Mass., wishes to know:

Q. 1. If he can obtain a Radio Engineer's course, and also wishes us to cite the several duties of a Radio Engineer and his salary.

A. 1. In becoming a full-fledged radio engineer of high standing, and especially those who wish to obtain a degree, one must at first have an elementary education at the high schools and then study at a university or college to obtain the degree of Bachelor of Science, Electrical Engineer or Master of Arts, and then pursue post-graduate work in Radio Engineering. This course is given by several universities and colleges about the country, in particular the College of the City of New York, Columbia Univeristy, University of Michigan, University of Washington and University of Pennsylvania and others. It should be understood, however, that one can study Radio Engineering aside from attending any University. It is not only the university trained man that makes the best Radio Engineer, but it is very often one's personal ability that may gain success just as well as the one who has had the advantage of a college training. Several important subjects which must be considered before one can obtain the degree or standing of Radio Engineer from either a professional school or university, include —elementary and advanced physics and mathematics, chemistry, a complete course in electrical engineering, also some other sub-topics, as history, economics, etc. The duties of a Radio Engineer are multifarious. At times he may be called upon to design a complete radio plant, both transmitting and receiving. Again, he may be sent out to superintend the erection of such a plant, and still at other times, he may be called upon to calculate and estimate the cost of material in the construction of such a plant. It is very difficult for us to outline the general duties of a Radio Engineer here owing to the limited space. The salaries range from $1,000 to $5,000 a year, depending upon the ability of the individual.

GENERATOR SIZE INQUIRY.

(703.) George Miller, New York City, desires to know:

Q. 1. What size generator would be necessary to operate a 1 K.W. Thordarson transformer?

A. 1. You should employ a 1⅛ K.W. Generator for running your 1 K.W. Thordarson transformer.

Q. 2. What would be the cost of one of the necessary size?

A. 2. We advise you to communicate with several of the firms listed in the advertising columns of THE ELECTRICAL EXPERIMENTER for this information

Q. 3. What H.P. would be necessary to run generator or would Ford engine be large enough?

A. 3. You should employ 1.6 H.P. engine to drive the generator or still better a 2 H.P. engine. The Ford machine is sufficiently powerful to drive the generator.

STORAGE BATTERY CHARGING.

(704.) Lee Porter, Connellsville, Ind., inquires:—

Q. 1. How would you connect a number of storage batteries on a circuit for charging?

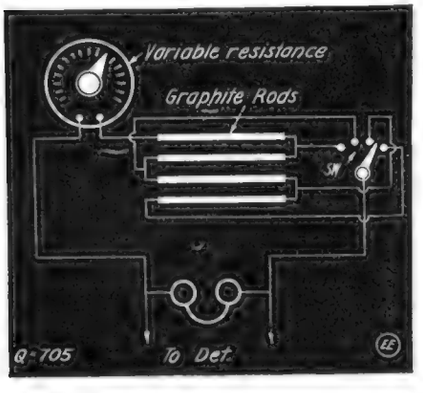
A. 1. The storage batteries should be connected in parallel when charging by a generator. However, this is determined by the voltage of the generating plant. For example:—Suppose that it is required to charge a series of batteries, say about ten, each of which are of six volts capacity and the generating plant is only rated for twenty volts. In this case the storage batteries should all be connected in series—parallel, i.e., two batteries in series and each file of two batteries connected on parallel. On the other hand, suppose that the same ten storage batteries are to be charged from 110 volt lighting circuit, then the batteries can be connected in series.

Q. 2. How would you regulate the voltage and the current if a mercury vapor rectifier was used?

A. 2. The voltage of a mercury vapor rectifier should be regulated by compensating resistances placed in the line circuit.

AUDIBILITY FACTOR IN RADIO RECEPTION.

(705.) Harold Kerrigan, Guthrie, Okla., desires to know:—



How Wireless 'Phones Are Shunted by an Adjustable, Known Resistance in Determining the "Audibility Factor."

Q. 1. How to measure the audibility and how to compare the intensity of signals in radio receiving stations.

A. 1. The usual method in comparing the intensity of radio signals is by shunting a high resistance across the telephone receivers and detuning the current intensity in the telephone receivers until a point is reached where the telephone does not respond to the distant signal. The ratio of the shunted resistance and that of the telephone re-

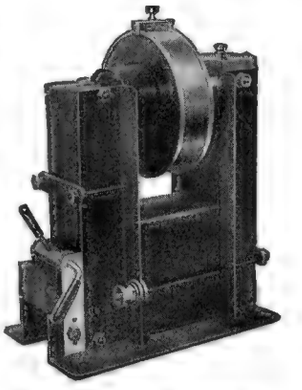
"Making New Records"

is the message constantly "flashed" to us by delighted users of the new model

THORDARSON

WIRELESS TRANSFORMER

The new "Type R" far excels even our own old models in range, efficiency and flexibility. Built with the accuracy of a watch, in the Thordarson laboratories, it stands **proved** as the "best wireless transformer on the market." Exclusive Variable Shunt and Ampere Scale. Comes completely assembled; no chance for mistakes or burn-outs. Five sizes, ½ to 2½ Kw., 10,000-20,000 volts, any cycle desired.



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Thordarson Electric Mfg. Co., 506 SO. JEFFERSON STREET CHICAGO, ILL.

Super-Sensitive Receiving Apparatus

We have a new and wonderful proposition to offer on super-sensitive receiving apparatus, detectors and accessories. Every one interested in wireless should have it. You had better send for it today—now—before you forget.

Equip Your Sets with INDESTRUCTO Potentiometer Controls

AudioTron Potentiometer and Rheostat Units are made of a special uniform composition and are designed to give silent, easy and close adjustment of battery potentials by a constant and gradual increase not possible with one cell variation. This results in maximum sensitiveness. The B battery unit is of 7000 ohms resistance, insuring long life to the batteries. Any lower resistance wastes your battery. The AudioTron Indestructo Filament Rheostat, having no wires to corrode, lasts a lifetime. Its ease of adjustment is also a big feature, and it adds to the appearance of your set.

B Battery Potentiometer Unit

Knob and Lever

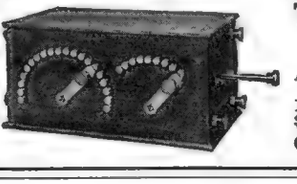
B Battery Potentiometer complete	$1.00
Less Lever and Knob	.50
Filament Rheostat complete	1.50
Less Lever and Knob	1.00
Lever and Knob	.50

READY FOR DELIVERY

OUR NEW COMPOSITION RHEOSTAT gives you the filament control for vacuum detectors you need. Write for description.

Satisfaction Guaranteed

Audio Tron Sales Co. **315 Lick Bldg., San Francisco, Cal.**



This 2500 Meter Selective and Efficient Tuner

ONLY $8.00

"Have used several tuners but none as efficient as the Colby tuner. Am highly pleased. Richard F. Morse, South Jacksonville, Fla."

10,000 Meter Undamped Tuner with switches, only $12.50. 15,000 Meter Loading Inductances in quartered oak case, with switches, only $8.00. Send 2 cent stamp for bulletin.

COLBY'S TELEGRAPH SCHOOL **Auburn, N. Y.**

S. O. S.!

When you get that thrillingly weak S O S you will appreciate the remarkable sensitiveness of our Improved Type A-9723 Head Set. Read this from an amateur wireless operator of Athens, Ga.:

"I have for months been nightly reading amateur stations—on Galena detector—anywhere from 400 to 1500 miles distant, some of them using less than 1 kw., and tests with other phones of higher price than yours fail to give any signals at all from these stations." (Name on request.)

Stromberg-Carlson
Radio Head Set

You will probably find this improved type A-9723 Radio Head Set—wound to 2000 ohms—at your dealer. If not, we will send it direct for $8.25. Keep it ten days. If it does not do all that we claim for it, if not satisfied that it is the best buy on the market, send it back and we will refund money without question.

Send for Bulletin No. 1006-C giving full description

Stromberg-Carlson Telephone Mfg. Co.
Rochester, N. Y.

A New and Remarkably Efficient

QUENCHED SPARK GAP

—FEATURES—

Absolutely silent.
Capacity ½ K.W. per section.
Voltage—10,000 volts per section.
Positively won't arc or pit.
Construction—All metal.
Insulating Ring—Bakelite.
Size—3 in. diameter.

Price $5.00 per section prepaid

You should try this gap

ROSENTHAL LABORATORIES
Camden New Jersey

ENCLOSED ROTARY GAP

Run it with your motor
Any Speed--Any Tone

The Gap runs in a cast iron housing and is silent in operation.

One Movable Contact Insuring Close Adjustment

MOUNTS IN ANY POSITION

Up to 1 K.W. **$8.50** | J. HERBERT FERRIS
211 Catalpa Drive
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sistance will give you the intensity or audibility factor of the signal being tested.

Q. 2. Can you give me a diagram of connections of an audibility meter which I can use in my station?

A. 2. The appended diagram herewith gives complete connections of an audibility meter. The high variable resistance should consist of a non-inductive circuit and this can be made usually by employing several (pencil (grafite) rods linked in series and each end terminated to several contacts which are controlled by a movable switch lever, so that the resistance of each can independently be taken. The instrument should be properly calibrated. Care should be taken in measuring the audibility of incoming signals that the sound in the receiver should barely be heard and then simultaneously taking the resistance reading of the shunted resistance. The audibility factor is then obtained by substituting the resistance of the telephones (R_t) and that of the shunted resistance (R) in the formula herewith given. It should of course be understood that the audibility factor is not a constant value but variable. Audibility factor $A = \frac{R+R_t}{R}$

For further details see Institute of Radio Engineers' Proceedings, Vol. 4, No. 4, page 363; also "How to Make an Audibility Meter" in our 25-cent treatise "How to Make Wireless Receiving Instruments."

Q. 3. What is the permissible logarithmic decrement that the Federal law permits one to use in a transmitting station?

A. 3. The highest logarithmic decrement permitted is .2.

Q. 4. What do you consider the best tuning arrangement for the transmitting station?

A. 4. It is generally found in practise that the inductively coupled system is the most suitable for tuning purposes, but the efficiency of transformation between primary and secondary of the coupler is so low in small sets that it is not always employed. In the direct coupled system the energy transformation is very high and thus it is far more efficient, but is not as selective as the inductively coupled arrangement, except when a Lepel or Poulsen arc or a quenched gap is utilized, which permits the use of a tightly coupled oscillation transformer such as a variometer or helix.

MEGGER TESTER.

(706.) Joseph Fairfield, New York City, wishes to know:

Q. 1. What is a *Megger* tester?

A. 1. A *Megger* testing set is a special direct reading ohmmeter which is used in measuring high resistance, such as insulation resistance.

Q. 2. What source of current is employed in this type of instrument?

A. 2. A high tension direct current generator is employed and this comprises one part of the instrument. A specially designed galvanometer is used with this dynamo and its scale is calibrated in megohms (1 megohm=1,000,000 ohms).

AUTOMATIC CIRCUIT BREAKER.

(707) John Olsen, Massachusetts, asks:

Q. 1. How is the automatic operation of a circuit breaker usually accomplisht?

A. 1. Usually thru the medium fo a solenoid or electro-magnet energized by current from the circuit controlled by the breaker.

Q. 2. What do you consider the best type of motor to be used for constant duty work? It is to be used for driving a water pump.

A. 2. We advise that you employ a shunt wound motor.

Q. 3. What is the difficulty encountered in starting a motor with single phase current? (*Continued on page 761*)

BOOK REVIEW.

(*Continued from page 758*)

ELECTRIC MOTORS, DIRECT AND ALTERNATING.

By David Penn Moreton, B.S., E.E. Cloth bound; 6¾x4½ inches; 242 pages, 115 illustrations. Francis J. Drake & Co., Chicago, Ill. Price, $1.00. 1916.

Professor Moreton has here endeavored to provide the practical electrician with a semi-technical handbook on alternating and direct current motors. There seems to be a good field for such a book, especially when the subject is discust by so well-known an authority.

The every-day electrician will find this book on electric motors of various types very valuable as it covers sufficient theoretical ground to give a good understanding of the exact action taking place in the motor. The principles of armature winding are explained and also how the number of armature conductors and the field flux are computed. Electrical tests and the necessary instruments are explained as applied to motor problems and the relations holding for the current, voltage and impedance in alternating current circuits is explained quite thoroly. A number of useful diagrams are given showing how to properly connect series, shunt and compound wound motors and the difference, both in operation and in connection, of the differential and the cumulative compound motor, a point which many electricians find difficult of comprehension.

The section on alternating current motors is treated in very simple language and covers such points as the percent of slip in induction motors; various types of A.C. motors, including the repulsion motor; connections and general characteristics of A.C. motor starting compensators with wiring diagram for two and three phase motors; method of starting a single phase induction motor by the split phase method, utilizing a condenser, and such points as reversal and speed control of induction motors.

HIGH FREQUENCY APPARATUS. By Thomas Stanley Curtis. Cloth bound; 246 pages; 7x5¼ inches; profusely illustrated. The Everyday Mechanics Company, Inc., New York City, N.Y. Price, $2.00. 1916.

A "How-to-Make-It" treatise on both large and small high frequency apparatus suitable for various requirements such as electro-therapeutics and plant culture, etc.

The forepart of the book takes up the design of A.C. transformers suitable for use in exciting Tesla and Oudin coils, and the work progresses with clear diagrams and descriptions of various types of spark gaps; high frequency transformers; kicking coil apparatus; quenched gap and high frequency sets; commercial physicians' sets and office equipment, etc.

Constructional data is given for building a high frequency set for use on the lecture platform or stage, involving the utilization of as much as 4 kilowatts. The large high frequency coils described for this work are intended to produce 60-inch sparks.

Hints are given on electrical entertainments with high frequency coils and a section is allotted to the construction details of a welding transformer, a piece of apparatus that is often used to good advantage in electrical demonstrations where two pieces of iron are to be welded together under water.

Those looking for a complete and practical treatise on the construction of various sizes of high frequency coils and necessary auxiliary apparatus, such as high tension condensers, spark gaps, etc., will find this volume very useful.

HOW TO READ TELEPHONE CIRCUIT DIAGRAMS. By David S. Hulfish. Cloth bound; 258 pages, 7¾x5⅝ inches; 570 diagrams. The Electricity Magazine Corporation, Chicago, Illinois. Price, $1.50. 1916.

All those interested in telephone circuits and the proper method of reading telephone blue prints, especially those used in commercial exchange installations, will find this volume very useful. It is profusely illustrated with over 500 illustrations, showing all of the various diversified types of relays and miscellaneous signaling and talking apparatus as identified with telephone installation blue prints, both large and small.

One of the greatest problems with which the ordinary telephone man meets is that of how to properly read and interpret complicated blue prints. By studying this book no trouble should be experienced in knowing at once just what instruments are connected at any point in a blue print layout.

The author has dealt in an interesting way with a very dry subject and deserves considerable credit. Not only is the exact function of each individual piece of apparatus explained and the standard method of connecting it, but its coaction with other allied apparatus in the circuit is also explained, so that a very fair knowledge of telephony can be obtained by studying the entire work.

(*Continued on page 762*)

A. 3. A single phase current requires either a synchronous motor to develop mechanical power from it, or a specially constructed motor, the idea of which is to provide a method of attaining rotation by foreign means and then to throw in the single phase current for power.

FLUXMETER.

(708.) John Kannedy, St. Paul, Minn., inquires:

Q. 1. What is a fluxmeter used for?

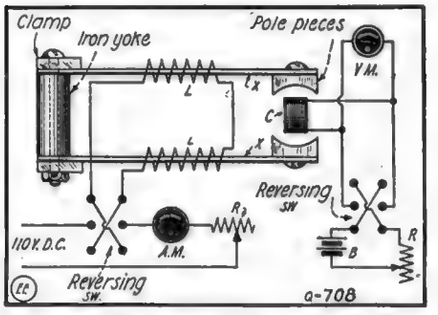
A. 1. A fluxmeter is employed for the measurement of the flux density in a sample of iron. They are usually calibrated to read in kilo-maxwells (thousands of maxwells or lines of force).

Q. 2. How is the fluxmeter connected?

A. 2. The diagram gives the general schematic arrangement of a standard type of fluxmeter. It consists of a rectangular frame. The two pieces of iron, X, X, under test are placed in the instrument and a specially designed coil is placed over each iron leg. These coils are connected in series and their ends connected to a reversing switch, and are energized with either a direct or alternating current, depending upon the nature of the test. Upon one end of the bar a galvanometer coil is placed which is used to indicate the flux density of the iron under test. This coil is connected to a reversing switch and battery as indicated. The flux density of the iron under test is read directly on the scale.

Q. 3. For what other purpose can the fluxmeter be used?

A. 3. It may be employed for testing the hysteresis losses and the magnetizing quantity of the iron.



Circuits and Arrangement of Apparatus in Measuring Magnetic Flux Density in Iron.

ALTERNATING CURRENT QUERIES.

(709.) Jack Segal, Brooklyn, N.Y., asks:

Q. 1. What do you mean by wave form when you speak of alternating current?

A. 1. There is always more or less irregularity in the shape of the current waves encountered in practise, depending upon the construction of the alternator. The ideal wave shape curve is the so-called *true sine wave* and is obtained with a rate of cutting of lines of force by the armature coils, equivalent to the swing of a pendulum which increases in speed from the end to the middle of the swing, decreasing at the same rate after passing the center. This swing is exprest in physics, as simple, harmonic motion.

Q. 2. How great may the angle of lag be?

A. 2. Anything up to 90°. It is the angle whose tangent is equal to the quotient of the inductance exprest in ohms or spurious resistance divided by the ohmic resistance. Also it may be exprest as the cosine of the angle of lag between the current and electro-motive-force.

Q. 3. What do you mean by resonance?

A. 3. The effects of inductance and capacity always oppose each other. If inductance and capacity be present in a circuit in such proportion that the effect of one neutralizes that of the other, the cir-

Holtzer-Cabot

RADIO RECEIVING PHONES

Read what Experienced Operators say about them

and remember—we guarantee every set. Money back if you are not satisfied.

"Have compared H-C phones with other makes costing from $5 to $20. The conditions during the tests could hardly have been more varied, ranging as they did from cold, clear atmosphere of winter to static charged month of July. Without exception H-C Phones have proven their superiority."

"We received undamped signals from Nauen, Germany, which is outside of Berlin. We merely used large undamped coupler which would tune up to 15,000 meters, three variable condensers and audion detector.

Holtzer-Cabot Phones were used, without any amplifying device."

"I have used your Light Weight Radio Receivers continually during the past two years, for the reason they have given entire satisfaction and are very efficient in "pulling in" weak signals.

While on the Mexican Border with the Massachussetts Signal Corps we used these telephones and the results were remarkable."

Send for Booklet 1697X **The Holtzer-Cabot Elec. Co.** BOSTON CHICAGO

OUR NEW CATALOG-F

CONTAINS A COMPLETE LINE OF

RAW MATERIALS

SEND FOR IT TO-DAY.

THIS ILLUSTRATION SHOWS one of the many new articles brought out especially for the wireless trade.

A. C. VOLT AND AMMETERS
PRICES
VOLTMETER—O to 125 Volts - - $8.50
AMMETER—O to 10 Amperes - - $8.00

MAGUIRE & SHOTTON
ALBANY, NEW YORK

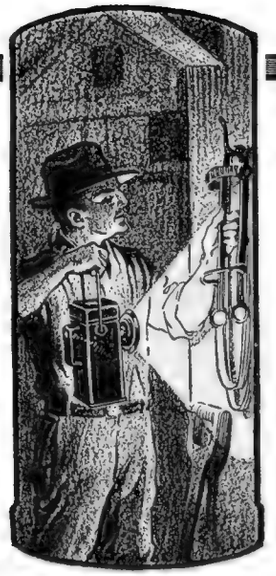
EUROPEAN STATIONS

HAVE BEEN RECEIVED WITH THE PHONES ON THE TABLE, using our copyrighted circuits and directions for securing the best results from a single bulb or tubular detector. Circuits for the regenerative, oscillating and amplifying audion. Short and long waves Amplifying powers with single audion up to one thousand times. No instruments not found in the usual amateur station required. A thousand miles may be covered using only a small indoor aerial. Germany has been repeatedly received on an 85 foot aerial using these circuits. Eight thousand miles common with long aerial. Circuit for using audion in experimental Wireless Telephone transmitter, no arc being required. Circuit for amplifying signals from Audio-Rotor or tikker through audion. Series of 12 blue prints with notes copyrighted 1916, printed with your name, postpaid 50 cents, stamps or preferably silver.

MONOTONE
IMPROVED QUENCHED GAP

Are you a leader or follower in adopting up-to-the-minute efficient apparatus? Equip your station with the famous MONOTONE IMPROVED QUENCHED GAPS, which are a big improvement over the original MONOTONE GAP. Span that freak distance on powerful waves of RADIO ENERGY. Each plate carefully machined. Best mica. Adjustable. One unit of the new gap for spark coils up to 3". One unit for every ¼ K.W. power of transformer. Specially recommended for powers below ½ K.W. Parts nickled and polished. You will be pleased with this new gap. Guaranteed. **Postpaid $2.50 Each.**

THE RICHARDSON CO., Manufacturers of Radio Apparatus **ERIE, PA.**



You Need a Good Flashlight

Along poorly lit streets, in dark hallways, or gloomy corners, a safe, sure, steady stream of brilliant white light is mighty handy.

With a FRANCO Flashlight and a Radio Battery, there's no danger of starting fires, blowing up or blowing out — you get real flashlight efficiency.

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and Radio Batteries are all definitely guaranteed. Made in seventy-five styles — you are bound to like some of them. Send for illustrated booklet and name of nearest dealer

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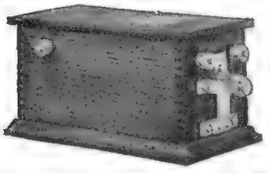
104-114 S. 4th Street Brooklyn, N. Y.



SPARK COILS For Wireless
STYLE C SPECIAL 1" COIL $3.50
Postage extra
FINE RESULTS WITH THIS COIL
SCHUG ELECTRIC MFG. CO.
254 EAST LARNED, DETROIT, MICH.

cuit acts as tho it were purely non-inductive and is said to be in a state of resonance. That is to say, when two circuits, containing capacity and inductance are excited and if the product of their inductance and capacity are alike, they are said to be in resonance.

TRANSFORMERS.

(710.) Alfred Jennings, Andover, Conn., desires a classification of transformers.

A. 1. As in the case of motors, the great variety of transformers makes it necessary that a classification, to be comprehensive, must be made from several points of view, viz.:

1. With respect to transformation as
   a. Step-up transformers;
   b. Step-down transformers.
2. With respect to the arrangement of the coils and magnetic circuit, as
   a. Core transformers;
   b. Shell transformers;
   c. Combined core and shell transformers.
3. With respect to the kind of circuit they are to be used on, as
   a. Single phase transformers;
   b. Polyphase transformers.
4. With respect to the method employed in cooling, as
   a. Dry transformers;
   b. Air-cooled transformers (natural draught, forced draught, or air blast);
   c. Oil-cooled transformers;
   d. Water-cooled transformers.
5. With respect to the nature of their output as
   a. Constant pressure transformers;
   b. Constant current transformers;
   c. Current transformers;
   d. Auto transformers.
6. With respect to the kind of service, as
   a. Distributing;
   b. Power.
7. With respect to the circuit connection that the transformer is constructed for, as
   a. Series transformers;
   b. Shunt transformers.

SPARKING OF MOTOR COMMUTATOR.

(711.) Earl Brisbain, Little Rock, Okla., asks:

Q. 1. What causes sparking on a motor commutator?

A. 1. Sparking occurs whenever there is a difference of potential between the brush and the part of the commutator that is passing out from under the brush. It is necessary, at times, to have the two commutator bars come under the brush, so the armature coil between them is short-circuited for an instant. If the machine is properly designed and constructed, and if the brushes are properly spaced, there should be no difference of potential between the commutator bar just coming under a brush and the bar just leaving it. This condition is not always met and there is apt to be more or less voltage between the two bars, due to the magnetic action of the current in the armature. Such voltage will send a current across the face of the brush independently of the main current, and the reason for using the high resistance carbon or other brush is to reduce this cross current, and therefore reduce the cutting of the commutator and brushes.

Q. 2. How can one tell if the resistance of the external circuit is low?

A. 2. The machine will usually build up its voltage if the main circuit is open, but will not build up when the main circuit is closed.

BOOK REVIEW.

(*Continued from page 760*)

Telephone draftsmen will find it a valuable aid as the drawings are well made and the explanations accompanying each of them are given in a very straightforward and technically correct manner.

OZONE—ITS MANUFACTURE, PROPERTIES AND USES. By A. Vosmaer, Ph.D. Cloth bound; 210 pages; 6x9 inches; 75 illustrations. D. Van Nostrand and Co., New York City, N.Y. Price, $2.50. 1916.

Dr. Vosmaer's work is one of the latest on the manufacture and industrial application of Ozone. The author has had considerable experience in the larger applications of this powerful germicidal agent and the treatise here offered contains many practical and authoritative passages.

The first part of the work considers the nature and chemical make-up of Ozone and also reactions of Ozone on various other chemicals. In the chapters dealing with the electrical production of Ozone, a number of new graphs are given for "brush" and "spark" discharge values under varying conditions, with regard to length of spark gap, the design of the gap and the nature of the atmosphere surrounding it, etc.

A number of excellent spark and brush discharge photographs are reproduced in some of the plates and the physical action occurring with various types and arrangements of multiple spark gaps are discust together with a number of special diagrams. Several graphs are given showing the relation between wattage, voltage, yield and polar distances.

The various standard types of Ozonators as manufactured by several electrical manufacturing companies are explained, including the Siemens-Halske type. Circuits are given for the several distinct methods of producing Ozone electrically as well as a description of the auxiliary apparatus generally used in conjunction with the high-voltage electrical transformer method.

Dr. Vosmaer's high-capacity Ozone Sterilizer, shown diagrammatically and in half-tone, is described as applied in the purification of water. The action in this case is both rapid and extremely efficient and data is given on a number of European installations, whereby Ozone is used in the purification of drinking water. A large folding plate shows a phantom view of the gigantic Ozone drinking-water purification plant, as used in the city of Paris, France.

The author covers the use of Ozone in therapeutics and other requirements. The work concludes with a list of U.S. patents bearing on Ozone and its generation, and a bibliography which contains a list of the more important papers and books which have been publisht on Ozone and the electrical apparatus and phenomena involved in its artificial production.

THE YEAR BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY. Cloth bound; size 6x 8½ inches; 1,000 pages; illustrated; price, $1.50. The Marconi Publishing Corp., New York City, N.Y. 1916.

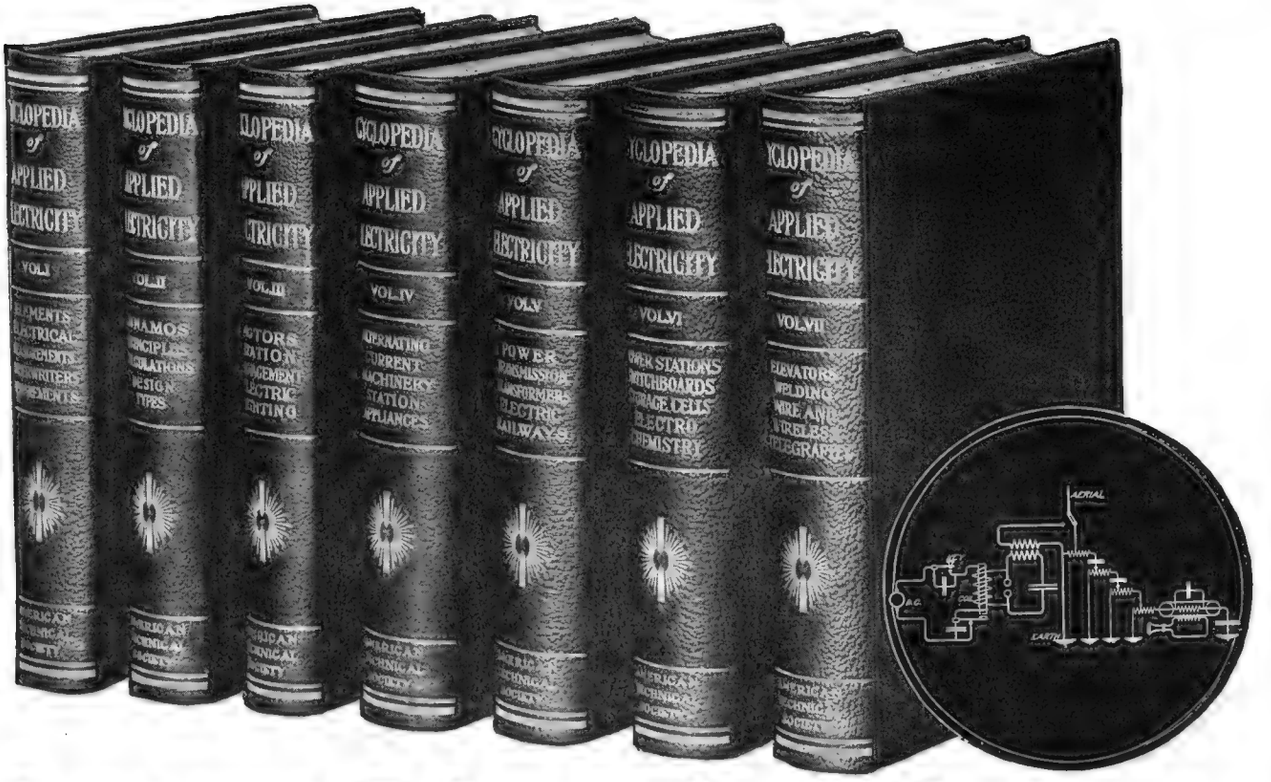
A valuable book for all radio men, containing a wealth of data in the form of tables, charts and specially prepared articles by men well known in the profession.

Among these articles we find: Intelligence in Naval Warfare; Photo-electric Phenomena; The Allies' Strategy in 1915; Capacitance, Inductance and Wave-Lengths of Antennae; Wireless Waves in the World War; The Progress in Radio Telephony in U.S.A.; Report of British Association for the Advancement of Science; Measurement of Signal Intensity; The Problems of Interference; Long Distance Service; Brief Outline of Radiographic Progress; International Time and Weather Signals; Formulae and Equations and Tables of Useful Data.

The work is well illustrated with photographs of various wireless men printed on coated paper suitable for framing. The wireless laws of different countries are given in detail and will be found of particular service to radio operators traveling in various parts of the world. The wireless calls, wave-lengths, ranges and hours of service are given for land and ship radio stations of all countries.

These are arranged alphabetically by countries and ships' names and also by call letters, so that the ship, its nationality or call letter can be instantly located. A glossary of technical electrical and radio terms is given as well as a dictionary of technical terms in five languages—English, French, Italian, Spanish and German. A digest and list of British and American Wireless patents for 1915 are given, also the names and addresses of the principal wireless telegraph companies of the world. A brief but valuable biographical section contains notes on the leading engineers and scientists who have been prominent in the development of the art. A list of wireless societies in different countries is included. Standard semaphore signaling is explained with charts showing the various positions of the semaphore arms. A large wireless map of the world accompanying the work will be found useful.

(*Continued on page 764*)



Latest Ideas in Wireless

THE latest invention in Wireless Telegraph and Telephony are all explained in the new Cyclopedia of Applied Electricity. This is not a set of handbooks but a complete encylopedia on applied electricity. The up-to-the-minute discoveries that are revolutionizing the business are all treated in detail. Here is a new Electrical Library that no one interested in Wireless Telegraph and Electricity can afford to be without. It is the latest work of its kind—and written in simple, easily understood language. You can get in on a remarkable offer.

Everything Electrical

The entire field of electricity is covered thoroughly in these seven volumes. Not in a brief manner but very complete. Everything explained fully. First you get the elements of electricity; then electrical measurements; the theory, calculation and design of generators and motors; dynamos; machinery; electric lighting; wireless telegraphy and telephony; etc., etc. All arranged for quick reference. This new edition of the Cyclopedia of Applied Electricity contains 3200 pages, 3000 illustrations, full page plates, diagrams, etc. 7x10 inches, bound in ½ genuine red Morocco, gold stamped. An aid to the student of electricity that cannot be reckoned in dollars and cents. A reference set that is the authority on Electricity, used by technical schools, libraries and practical men in the Electrical Field.

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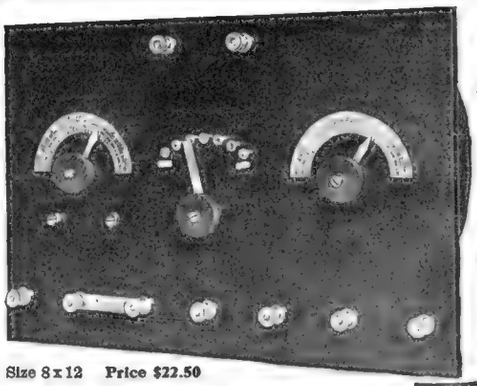

Multi-Audi-Fone

M.A.F. Short Wave Regenerative Attachment

The M. A. F. Short Wave Regenerative Attachment is the latest and highest achievement in the field of regenerative circuits.

When this instrument is attached to your present loose coupler and Audion you will be able to receive those long distance relay messages.

With this M. A. F. Attachment the operator is able to receive amateur and commercial stations ranging from 150 to 3,000 meters—damped and un-damped—and amplify both of them to a most remarkable degree.

Size 8 x 12 Price $22.50

Multiform Receiver

The Multiform Receiver is the latest development and most advanced step in the wireless field and gives to the operator that comprehensive instrument that he has long looked and hoped for—that is a single receiving set which combines a straight Audion circuit, the new regenerative circuit and long wave undamped circuit.

On any ordinary aerial the Multiform Receiver has a wave range running from 150 up to 15,000 meters.

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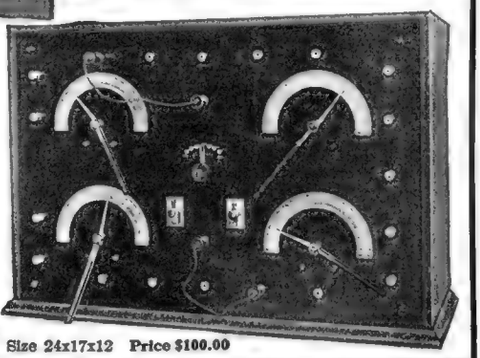
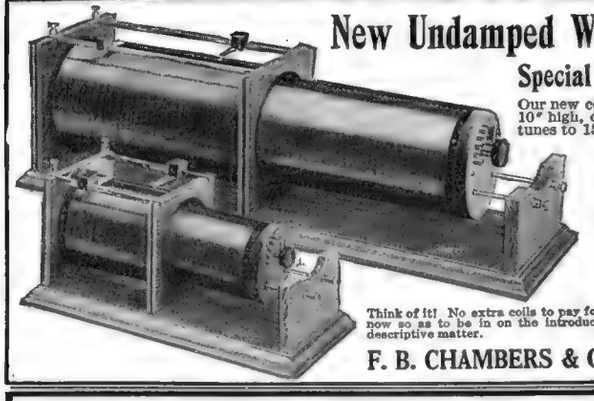


MULTI-AUDI-FONE
275 Morris Avenue Elizabeth, N. J. Size 24x17x12 Price $100.00



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Special Introductory Price, $18.00

Our new coupler No. 749 is 32" long, 9" wide, and 10" high, over all, and on an average-sized Antenna tunes to 15,000 meters. This coupler, used with the new CHAMBERS' SYSTEM or CIRCUIT, will bring in signals from domestic and foreign Arc Stations surprisingly loud and clear. Note the difference in size of our No. 748 and No. 749.

We claim to be the original inventors of a SYSTEM or CIRCUIT for the reception of the undamped waves without the use of Loading Coils or Oscillating Coils, as they are sometimes called; as with our SYSTEM or CIRCUIT only two Inductively Coupled Coils are necessary. Circuit supplied with each coupler.

This CHAMBERS' CIRCUIT saves you money.

Think of it! No extra coils to pay for, and price of coupler only $18.00. Place order now so as to be in on the introductory price. Orders filled in rotation. Send for descriptive matter.

F. B. CHAMBERS & CO., 2046 Arch St., Phila., Pa.

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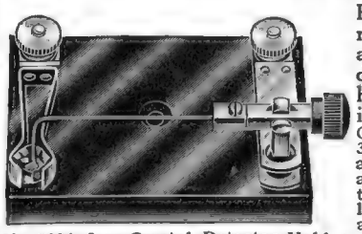
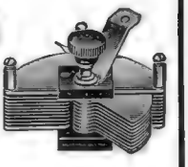


Best and most durable. Up-to-date dealers have them in stock.

Our Catalog 36E illustrates and describes about 300 articles of wireless apparatus as well as other appliances. Send 2c stamp for it, to



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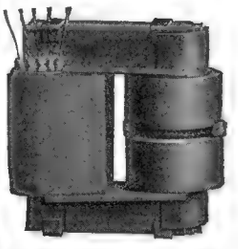


Every user reports exceptional range with these instruments and loud messages are secured every time.

Many amateurs buy one of these unmounted and build their own transformers at low cost.

Write for details and Wireless Bulletin T207

The Packard Electric Company

WARREN OHIO

BOOK REVIEW.

(*Continued from page 762*)

DYKE'S AUTOMOBILE ENCYCLOPEDIA. By A. L. Dyke. Cloth bound; 6¾x9¾ inches; fifth edition; 824 pages; 2,370 illustrations. Price, $3.00 net. Publisht by the Author at St. Louis, Mo. 1916.

This remarkable book contains in addition to the fifty instructions, supplements on the Ford, Packard and King cars, part of which is printed in two colors. There are 350 pages and 976 illustrations on electrical subjects. There are 74 pages and 254 illustrations on testing electric auto systems with 74 pages and 75 illustrations on the Delco systems alone.

It is really difficult to even start enumerating the vast number of complex subjects treated on in this compendium. Everything is thoroly illustrated. One cannot fail to understand how the gear shift operates, or how the ignition system on any car works of no matter what type, if he will study this valuable treatise carefully. Electric starting motors and their mechanical and electrical attachments are well illustrated and explained by numerous sectional drawings as well as the control wiring, etc. Various forms of auto generators and magnetos are discust at length and their action made very clear.

One of the chapters deals with the all important subject of the care, adjustments and tests of electric starting, generating and lighting systems. The simpler faults are illustrated by diagrams so that the novice will find them easy of comprehension. The proper method of wiring a car for any standard electric lighting and starting system is dealt with in a concise and practical manner. Storage batteries and various methods of charging them by rectifiers, lamp banks, etc., are explained in detail. Extension tables containing the horsepower, ignition, cylinder sizes, etc., of all the leading cars are given, as well as data on all sizes of electric head-lamp bulbs and a list of car parts no longer manufactured and where to obtain them. Automobile repairing is covered in considerable detail with many valuable hints. If you would know *all* about *all* automobiles, this is the book to get.

MANUAL OF WIRELESS TELEGRAPHY FOR 1916, publisht by the Manhattan Electrical Supply Co., New York. 180 pages, 6x9 inches, paper bound. Price 10 cents.

This book was publisht for the purpose of giving the modern amateur and radio dabbler an opportunity of getting more information and cost of modern radio apparatus.

The book is entirely devoted to the wireless field. The opening chapter treats with the fundamental principles of the art and follows up with the more advanced theory. Numerous formulaes, tables and curves are given, these are very valuable to the one who is interested in the mathematical scope of wireless telegraphy. A large number of wiring diagrams are also given beginning with the simple receiving outfits to those of the modern regenerative Audion receiving outfits. It also treats on different transmitting sets.

One of the most interesting features of this Manual of Wireless Telegraphy is that it contains illustrations, descriptions and prices of most all of the modern radio apparatus which are manufactured thruout this country.

U. S. RUSHES WORK ON WIRELESS LINKS.

The work of linking up all parts of the United States and its island possessions with powerful wireless stations has gone forward with unprecedented speed, according to the annual report of the chief of the Bureau of Steam Engineering of the Navy Department.

The San Diego station, which is one of the most powerful in the world, opened January first, and those at Pearl Harbor and Cavite will follow within a few months.

The equipment of the stations at Boston, Great Lakes, Charleston, Key West, New Orleans, Guantanamo, San Juan and Cordova, Alaska, has been so improved as to permit them to relay messages across the continent.

Plans for a medium power station at Porto Rico are under preparation and contracts have been signed for the erection of a high-power station at Guam.

Part of new wireless equipment designed for aeroplanes is contained in a helmet that is intended to bar other sounds from an aviator's ears.

STANDARD RADIO TERMS DEFINED.

Approved by the Institute of Radio Engineers.

Under this head we will define the most important radio terms each month. Save them and by pasting each in a book (properly indexed) you will have a handy radio dictionary.

2001. *Alternator, Alexanderson:* By General Electric Company.
The Alexanderson Alternator is an alternating current generator for radio frequency having a rotor of solid steel shaped as a disc for maximum strength and provided with inductor poles, and having stationary armatures with radial faces on both sides of the rotating disc.

2002. *Audion:* By De Forest Radio Telephone & Telegraph Company.
The Audion is a relay, operating by electrostatic control of currents flowing across a gaseous medium. In its present commercial form, it consists of three electrodes in an evacuated bulb, one of these electrodes being a heated metal filament, the second a grid-like electrode, and the third a metal plate; an input circuit connected to the filament and the grid; and an output circuit connected to the filament and the plate, including a local source of energy and a telephone receiver.

2003. *Chopper:* By Federal Telegraph Company.
A transmitting device for repeatedly changing circuit connections at a uniform high rate of speed. The object of the above operation is to cause a continuous variation at audio frequency of the energy radiated at a fixed wave length from an antenna.

2004. *Gap, Quenched:* By the National Electric Signaling Company.
A spark gap provided with means for minimizing arcing and generally used under conditions which prevent the retransfer of energy between the primary and secondary oscillation circuits.

2005. *Gap, Synchronous Rotary:* By the National Electric Signaling Company.
A rotary spark gap which produces discharges in synchronism with the supply of alternating E.M.F.

2006. *Heterodyne:* By the National Electric Signaling Company.
A receiver for radio frequency signals which operates by the production of interference beats between two radio frequency currents or voltages, the source of one of these radio frequencies being located at the receiving station.

2007. *Kenotron:* By General Electric Company.
Kenotron is a name applied to a general class of apparatus having an incandescent cathode and operating with a pure ionic discharge in a vacuum so high that gas ionization plays no essential role. One of the uses of the kenotron is the rectification of alternating current, particularly of high voltage.

2008. *Pliotron:* By General Electric Company.
A Pliotron is a Kenotron provided with a member for electrostatically controlling the ionic discharge.

2009. *Telegraphone:* By the Telegraphone Sales Company. The Telegraphone is an instrument for recording and reproducing sounds by the impression of magnetic fluxes proportional in intensity and frequency to the sound waves, upon a moving steel mass. These magnetic fluxes are set up in the steel mass by a suitably placed electro-magnet in series with the telephone transmitter, and constitute the record. Passage of these fluxes across the poles of the electro-magnet in series with the telephone receiver, reproduces the sounds.

2010. *Tikker:* By the Federal Telegraph Company.
A receiving device for changing circuit connections in such a manner as to render the sustained radio frequency electrical energy stored in an oscillating circuit, available for operating a telephone receiver.

2011. *Ultraudion:* By De Forest Radio Telephone & Telegraph Company.
The Ultraudion is an Audion connected in a circuit having a type of energy coupling such that a powerful relay action, or even the production of sustained oscillations may be obtained. In one of its present commercial forms its elements are connected in two circuits so arranged that the energy coupling may be obtained through a bridging condenser in its filament-plate circuit.

(*Finis*)

WORCESTER POLYTECHNIC BRANCH OF THE A.I.E.E.

William J. Hammer, consulting electrical engineer of New York City, lectured before the Worcester Polytechnic Branch of the American Institute of Electrical Engineers on the evening of December fifteenth upon "The Selenium Cell and its Scientific and Industrial Applications."

Mr. Hammer brought with him various types of selenium cell apparatus and showed, by means of lantern slides, various applications of the *selenium cell,* such as the telegraphic transmission of pictures, telephoning over a beam of light, seeing at a distance, firing cannon and steering marine and aerial torpedoes by means of a searchlight-beam, protection of safes from burglars, and boilers from explosion. Also recorders of snowfall and eclipse observations, telegraphic relays and signal devices, railway safety devices, methods of control of dynamos and motors, selenium photometers, stethescopes, automatic electric buoys, talking motion pictures, etc.

THE TRENCH DESTROYER

(*Continued from page 714*)

rolled over it, the best defended trench will be pretty well demoralized. By this time our infantry has rushed up from behind and in a few minutes the trench has been captured. The first Trench Destroyer now turns around and runs up to the second parallel trench of the enemy and here the same maneuver is repeated. In less than half an hour all the parallel enemy trenches have been captured over a broad distance.

Unless the enemy's artillery is stationed on the hills, it will be forced to fall back as soon as the formidable Destroyers creep up close to the gunners. The retreat has begun—once more both the defensive and the offensive are mobile again and the battle can be fought out in the field, as it should.

Our accompanying illustration shows the technical details of the machine clearly for those interested in its study. The Destroyer is a simple matter of military engineering and construction, and it should not cost more than $25,000 to build one.

There are two 65 horsepower motors, driven by a 160 horsepower gasoline engine. The total weight of the machine is some 60 tons, which is less than a small freight locomotive.

The machine will run across country, will ford small rivers and run up low hills. Rather steep hills can be negotiated by running the Destroyer uphill in zig-zag fashion.

As usual our wise friends will say: "Yes, your machine may be a good idea, but what happens if the enemy *too* has Trench Destroyers?"

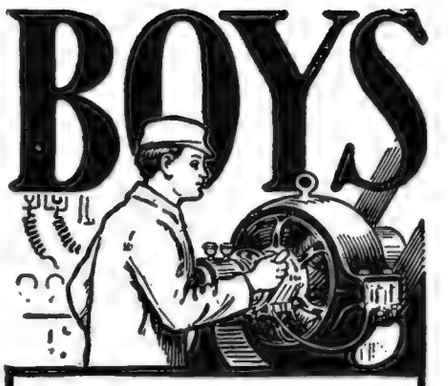
Nothing at all happens. When the commanders of the contending armies KNOW that the opponent has Trench Destroyers, neither will allow his men to entrench themselves. Both commanders know it would be useless. Herein lies the usefulness of the machine. It keeps the men in the field where they belong.

WIRELESS PLANT FOR THE NAVAL MILITIA.

Preparations are being made for the installation of a wireless system at the headquarters of the 10th deck division at the high school building in Marblehead, Mass. Lieutenant Chester L. Dane has secured enough funds from the State to install the system, which will be the first to be installed for any deck division in the State.

The wireless station will be equipt for receiving calls, but none will be sent.

Several members of the division will be in charge of the station and later an instructor will be furnished by the State to instruct other members of the division.



Big Money in Electricity

The Electrical industries offer wonderful opportunities to boys with a liking for Electricity. The salaries paid to trained men are large, promotion comes rapidly and, best of all, the work is fascinating.

The discovery and development of new lines (such as wireless telegraphy and telephony), from time to time, promise attractive and paying fields to those who wish to specialize. The *will to do* and *Special Training* will bring success to *you.*

The International Correspondence Schools can help you to become an expert in electrical work, no matter what branch you like best. Thousands of young men have already won success through I. C. S. help. You can do as well as anybody, *if you try.* Everything is made so clear that you can learn in your spare time, regardless of where you live or what your work. No books to buy.

There's big Money in Electricity. Get after it by marking and mailing the Coupon today. *Finding out costs you nothing.*

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Explain, without obligating me, how I can qualify for the position before which I mark X.

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☐ Electrician	☐ CHEMICAL ENGINEER
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☐ Practical Telephony	☐ ADVERTISING MAN
☐ Electric Wiring	☐ Window Trimmer
☐ Electric Lighting	☐ Show Card Writer
☐ Electric Railways	☐ Outdoor Sign Painter
☐ Electric Designer	☐ RAILROADER
☐ MECHANICAL ENGINEER	☐ ILLUSTRATOR
☐ Mechanical Draftsman	☐ ARCHITECT
☐ Gas Engineer	☐ Architectural Draftsman
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☐ Surveying and Mapping	☐ Teachers Course
☐ Metallurgist	☐ Common School Subjects
☐ STATIONARY ENGINEER	☐ CIVIL SERVICE
☐ Concrete Engineer	☐ Railway Mail Clerk
☐ Structural Engineer	☐ AGRICULTURE
☐ BOOKKEEPING	☐ Navigator ☐ Spanish
☐ Stenographer and Typist	☐ Poultry Raising ☐ German
☐ Cert. Pub. Accountant	☐ AUTOMOBILES ☐ French
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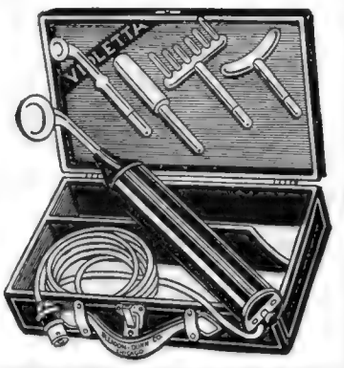
Produces SOOTHING, INVIGORATING, CURATIVE VIOLET-RAYS. Wonderfully quick results obtained in treating SCALP, FACE and BODY. Health bringing OZONE forced into the blood, producing an abundance of VITALITY.



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to secure a GOOD storage battery at a moderately LOW cost. The ONE article you cannot afford to experiment with is a storage battery.

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6C2	6	40	10.00	6.00
6C4	6	60	12.00	7.20
6C6	6	80	16.00	9.60

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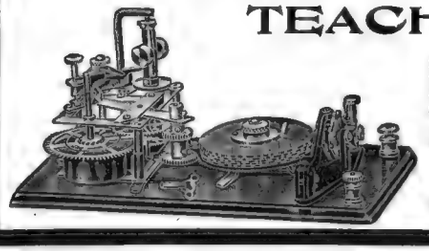

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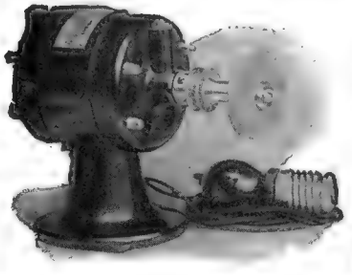

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ELECTRICITY, THE WONDER DOCTOR OF THE AGE.

(*Continued from page 711*)

cases of new or chronic rheumatism, gout, sciatica, lumbago, neuritis, ankylosis, neuralgia, abnormal blood pressure, arthritis, stiffness of joints following splint and cast treatment of fractures and dislocations,

First we saw a patient receiving a *dry hot air* treatment in an electric bake oven. By a specially designed structure of this oven, the phenomenal high temperature of 400 degrees Fah. can be applied to a limb or to the whole body as required. The secret of applying such remarkable temperatures—212° Fah. means the generation of steam from water—lies in the fact that these wonderful ovens are so built that all moisture is removed from the hot air before it comes in contact with the body. *Absolutely dry hot air* is the quantity sought for such treatment and here it is obtained in abundance. The patient suffers no discomfort—even sleeping while the heat—thousands of calories of it—sinks into the diseased tissue or joint and performs its miraculous wonders.

Having observed how deftly and scientifically this class of patients were treated, we proceeded to another chamber, resplendent in its natural daylight and white walls. Here, the Doctor explained, patients requiring it were given the *Dowsing radiant heat and light treatment.*

This constitutes the foremost among all the newer modifications of apparatus which aim to supply an increased dosage of rays and which contribute to the production of tonic and natural warmth for physiological effects. Special electric globes with special filaments, and special designs of instrument—all to produce *Warm Sunshine.* A noted Berlin physician says of this instrument and its use: "Those of you who have seen and examined this apparatus must confess that it produces a very splendid radiation of dry, luminous heat, with advantages which no other heat producer possesses. It develops a heat of 250°F. to 300° F. in a few minutes. The heat, as heat, does not burn in the ordinary way; you feel it as warmth, but it does not sting and burn. Since introducing this apparatus in my house, I have treated and am now treating patients with all kinds of ailment, from incipient cold to complicated and very obstinate sufferings. The patient will tell you he enjoys the soft, luminous rays like *basking in the sun.*"

This treatment—one of the most pleasant to apply and withal extremely efficacious, particularly in cases of deafness due to sclerosis, where the superheated dry air applied directly stimulates the local circulation, increases absorption, improves the nutrition and hence produces a remarkable improvement in the hearing.

Thousands of dollars were expended in developing the Dowsing heat ray treatment apparatus. Some of the couches are fitted with a number of these reflectors and after the patient is properly placed between them, a large asbestos curtain is drawn around the couch, to prevent the escape of heat. A *local* Dowsing applicator is here shown, being applied to the patient's back by one of the electro-therapeutical experts.

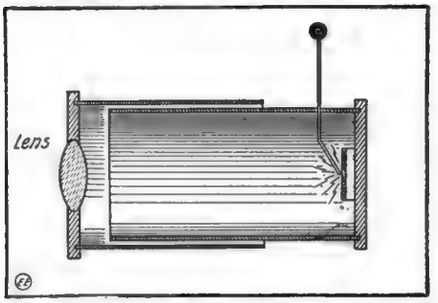
Among other applications of electricity available at this establishment are those involving high frequency and static currents at ultra-high potentials. Massive static machines, with multiple revolving plates 36 inches in diameter supply the static current. Many physicians send their patients, requiring electrical treatment, to this wonder hospital of the age, if so we may call it, as not every doctor has the necessary equipment.

Next we entered the *Arthromotor* room, a view of this truly ingenious and electric-

(*Continued on page 774*)

MAKING LUMINOUS RADIUM PAINT.

Many of us have been enchanted, no doubt, upon first looking into a *spinthariscope*, an instrument devised by Sir William Crookes and the operation of which is based on the fact that certain fluorescent and phosphorescent and mineral compounds, especially zinc sulfid, are so sensitive to radioactivity that they show luminescence when brought near radium. This device consists of a dark chamber inclosing a disk of cardboard that is coated with zinc sulfid. A small wire is fixt above the disk so that one end of it is very close to the sulfid but not touching it, and a microscopic speck of a salt of radium is attached to this end of the wire. When this combination is observed thru a magnifying lens of proper power, the zinc sulfid is seen to be perpetually scintillating with innumerable little stars in the vicinity of the radium. This appearance is caused by the alpha rays that are discharged from the radium with tremendous velocity, some of which bombard the sulfid like atomic cannon balls, every hit producing a flash of light on the target. W. S. Andrews, in the *General Electric Review* describes how by mixing a very minute amount of a radium salt with finely-powerded zinc sulfid and a suitable adhesive a luminous paint is obtained. It is used on the hands and dials



The Spinthariscope, an Instrument for Demonstrating Radioactivity by the Bombarding of Zinc Sulfid by the Alpha Rays.

of watches and clocks, on the pointers of aeroplane compasses, on electric switch boxes, etc. It should not be confounded with the older Balmain's luminous paint, the base of which is a special preparation of phosphorescent calcium sulfid, and which requires the excitation of a strong light to make it shine. It absorbs the luminous radiation and then emits it again as a soft phosphorescent glow which gradually fades away, so that in the course of a few hours it ceases to be visible until again excited to phosphorescence. The self-luminous radioactive paint differs entirely from the above in containing within itself its own exciting power, so that it continues to shine indefinitely even when kept in perpetual darkness. As we know, Radium has a "half period" decay of 1750 years, hence the radium in the paint is everlasting for all practical purposes, but the amount of luminous quality locked up in the zinc sulfid is exhausted in time. By increasing the ratio of radium salt to zinc sulfid in the paint, the luminescence is increased, but the useful life is reduced. For army and navy purposes the United States Government calls for a guarantee on self-luminous paint that it shall maintain an undiminished luminosity for two years. Thorium is also radioactive and may be used together with radium in the paint. Meso-thorium, from which radio-thorium is evolved, is a by-product of the incandescent gas mantle industry and on account of its relative cheapness as compared with radium it is now being used extensively either by itself or combined with radium in the production of self-luminous paints.

CABLE MESSAGES RECEIVED BY EAR NOW.

A technical discovery expected to revolutionize ocean cable communication was recently announced by the U. S. War Department. The discovery, the results of experiments initiated and carried out under the direction of Lieutenant-Colonel George O. Squier, U.S.A., Chief of the Aviation Section of the Signal Corps, will permit the reception of Morse signals in ocean cable communication audibly instead of visually by flashes, as at present.

The principal drawback to cable communication has been the necessity of employing the visual recorder, requiring the employment of highly trained cable readers. The new invention—the "Audion cable receiver"—is expected to do away with cable readers and bring the operation of ocean cables in line with land line and radio-telegraphy.

The official announcement regarding the invention states in part:

"The preliminary experiments, which have been in progress for some months, were made at the Government radio laboratories, and the actual tests on an ocean cable have been completed recently. The improvement consists essentially in the adaption of the 'tikker' and Audion types of instrument used for receiving the signals in radio-telegraphy.

"The tests have been made on the Government Signal Corps cable from Sitka, Alaska, to Seattle, Wash., and the receiving apparatus was installed in the Seattle office. This cable is 1,086 miles in length and has a K. R. approximately equivalent to one of the Atlantic cables.

"The actual receiver is an ordinary telephone. The feeble current received is normally inaudible in the telephone. It is broken up by means of a slipping contact 'tikker' and rendered audible. In order to secure greater sensibility, a tuned Audion amplifier is used in connection with the tikker. The sensitiveness of this apparatus is so great that less than one-twentieth of the voltage necessary for operating the 'siphon' recorder is sufficient to give good traffic signals.

"The significance of this development may be realized when we remember that at present all the traffic for ocean cables has to be translated into an entirely different code at each end and that highly paid cable readers are required to decipher these messages. The present discovery brings the operation of ocean cables in line with land line telegraphy as well as radio-telegraphy. The increased sensitiveness obtained by this method guarantees the operation of ocean cables under conditions when they would be totally interrupted as at present used and forecasts radical improvements in the world engineering practise of cable telegraphy.

"The experiments have been initiated and carried out under the personal direction of Lieutenant-Colonel George O. Squier (who invented and patented a few years ago an ingenious system of 'wired wireless,' involving the application of radio frequency oscillations to land telegraph or telephone lines and which, it was predicted, would enable perfect communication over lines 10,000 miles in length), Signal Corps, United States Army, by Dr. Louis W. Austin, in charge of the Naval Radio Laboratory, Bureau of Standards, and Dr. Louis Cohen, Consulting Engineer of the Signal Corps.

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THE MECHANISM OF LIGHT PRODUCTION IN ANIMALS.

(*Continued from page 719*)

with non-luminous insects or extracts of pill bugs, earthworms or slugs.

Whether the luceferin and luciferase of all forms are identical is still an open question. We know of many organic substances such as oils, alcohols, lophin, etc., which will phosphoresce at relatively low temperatures with alkalies, so that it would be by no means remarkable to find that the luciferin of different forms was different. I have this past winter discovered a luminous reaction which is remarkable in many ways and which closely parallels the method of light production in luminous forms. Pyrogallol will produce light with the vegetable oxidases (potato or turnip juice) if we add some hydrogen peroxid. As little as one part of pyrogallol in 254,000 parts water will give perceptible light. Faint light is produced at 0° C. and a good light at 10° C. A characteristic of luminous animals is that they still produce light at 0° C. The pyrogallol+H_2O_2 corresponds to luciferin and the vegetable oxidase to luciferase. Like the luciferase of luminous forms the oxidase is destroyed by boiling. We might therefore separate a luminous mixture of pyrogallol+H_2O_2 and potato juice into a thermostabile and thermolabile component which would again give light if brought together. Mammalian blood may take the place of the oxidase of plant juices.

EXPERIMENTAL PHYSICS.

(*Continued from page 727*)

gradually into the water (the greater depth possible the better); we are conscious of a certain force pushing against us, trying to prevent us from pushing the test tube down; and this force becomes larger and larger as the test tube is pushed deeper and deeper. On examining the test tube, we note that there is very little water in it; (see Fig. 3) more and more water enters the tube as we push it deeper and deeper. Care should be taken not to tip the test tube over, in order that the experiment may be successful. A consideration of this very simple experiment will reveal a great principle.

The reason why the water did not fill the test tube was that only one body can occupy the same space at the same time, i.e., the air and the water could not both occupy the test tube space. If, however, we carelessly tipt the tube during the experiment, the air might have escapt from it and the water taken its place. The pressure at the surface of the water was just equal to the pressure of the air, i.e., the weight of the air column above the surface of the water. Therefore, the pressure of the water at its surface was equal to the pressure of the air in the test tube. When the test tube was pushed down the pressure of the water at the surface of the air in the test tube was becoming greater and greater while no more air could enter the test tube. Hence the air in the test tube was comprest until its pressure equaled the pressure of the water at the air-water surface and the water gradually rose in the test tube. Obviously the water could never fill the whole test tube, since for this to happen, the air in the test tube would have to be comprest into nothing; but more and more water would enter the test tube as we immersed it deeper and deeper. If while the tube is immersed we suddenly let go, we find that it is pushed up to the surface; and the lower the test tube is when it is released the more rapidly it comes to the surface. We conclude that when a gas (air) is comprest it is capable of exerting great force; i.e., a larger amount of gas than usual in a given volume exerts a large force and the force for a given volume depends on the amount of the gas comprest into the volume. Careful measurements show that if we take a given amount of gas and compress it so that it occupies half as much volume, the pressure of the gas is twice as great; for one-third as much volume, the pressure is three times as great; for one quarter as much volume, the pressure is four times as great, etc., etc. This shows that the pressure times the volume is in the first case one-half times 2, in the second case one-third times 3, in the third case one-fourth times 4; all of which are equal to the same quantity-one. This is Boyle's Law of gases and can be stated briefly: Any gas whose quantity is always the same, the pressure it exerts multiplied by the volume it occupies, is always the same.

EXPERIMENT 3:—Examine a pop gun. It consists of four parts, a wooden tube, a cork projectile, a piece of string connecting the projectile to the tube (in order that the projectile may not be lost), and a piston consisting of a cork with a handle glued to it. The pop gun presents the most elementary form of explosion and makes use of the explosion to propel a projectile. At first the cork projectile is placed firmly in the end of the tube (fitting tightly). The piston is then pushed in swiftly at the other end until suddenly a report is heard and the projectile shoots forward, being prevented from going straight ahead by the string. Sometimes the string is weak enough for it to be broken by the force exerted. At first the air in the tube is at the same pressure as the surrounding atmosphere. As the piston is pushed forward, the air is comprest since it cannot escape and as it is comprest more and more, its force becomes greater and greater, until finally it is sufficient to push out the projectile. This is another case of a larger amount of gas than usual in a given volume exerts a large force and the greater the compression the greater the force. If the piston is pushed in gently no explosion will occur, as the air will gradually escape along the sides of the piston and we obtain no explosion. The suddenness (time period) is always an important factor when dealing with forces.

Everyone has had the experience of trying to open a door that is stuck and will not yield. The door does not yield to a slow, steady force, but often will to a sudden one. The ordinary pneumatic door check works on this same principle and anyone handy with tools and possessing a little ingenuity, can easily convert a pop gun or bicycle pump into a door check. In Fig. 5, (a) is a tube closed at one end, (b) is a piston. The closed tube can be attached to the doorway and the piston to the door, or vice versa, so that when the door is closed the piston just fits into the tube snugly. If a spring is attached to the door it would cause the door to slam shut, pushing the piston in rapidly, which is the same as happens in the case of the pop gun. In the pop gun the compression caused the end cork to fly off, but in this case, since the end is closed up, the effective compression force will be exerted on the piston itself and hence the piston can return only slowly as the air gradually goes out along its sides. This causes the door to close gently.

The air rifle is quite similar to the pop gun. We can also look at it from this standpoint. Air *is* an actual substance since it can be weighed, carried about, etc. Hence if a piston pushes the air against a buckshot, the buckshot will move forward just as if it had been pushed by a stick or some other solid. Since if we pushed against a buckshot with a hollow stick, the stick would pass around it (see Fig. 6) and the buckshot would not move,

so the air hole in an air rifle must be small to prevent the air from simply passing around the buckshot. That is why we cannot shoot needles with an air rifle. The air hole is too large for the needle and the air passes around the needle without pushing it out.

(*To be continued*)

THE HOW AND WHY OF RADIO APPARATUS.

(*Continued from page 735*)

ly stating that one plate gathers *positive* and the other *negative* electricity. This assumption of lack of definiteness was taken up by Maxwell, he making the assumption that, although the plates of the condenser be separated and kept apart by an insulator, an action takes place in the insulator itself which is something like the action of electricity flowing thru a conductor.

Exactly what means Maxwell employed to work out his idea along this line is unknown, but Professor Pierce represents Maxwell's idea by supposing that the insulating medium of a condenser, whether it be glass, oil, or air, is made up of small parts and that the electricity in these small parts of the dielectric or insulator may flow easily in the small parts themselves, but cannot flow from one part to the next. This may be on account of the insulating

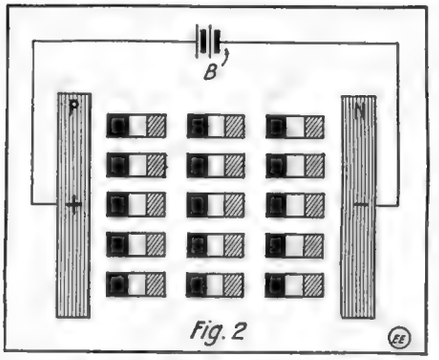

Diagram Showing How Molecules in Condenser Dielectric Are Polarized.

properties of the dielectric. If we think of these small parts as molecules, this assumed current in the dielectric may be the action of polarizing the molecules. For illustration, assume that the two plates of a condenser in Fig. 2 marked + and − which are separated by a dielectric, are being charged by the battery B. The + plate at the left is attracting negative electricity and repelling positive electricity in the layers of molecules nearest it, and that part of each molecule of the layer nearest the positive plate by the law of charges, becomes negative, and the part farthest from the positive plate, becomes positive. Molecules in this condition are termed *Polarized Molecules*. Each layer of the molecules thus polarized will act upon the next layer, producing the same effect of polarization, so that all the molecules of the entire dielectric acquire this polarization.

Some investigators have stated that this action is typically and merely electricity produced by induction, and altho there is not an actual transfer of electricity between the dielectric molecules themselves, as we would think of electricity being transferred on a conductor, the effect of this general transfer of electricity by Induction is the same as if the dielectrics were a conducting substance. This transfer of electricity in the dielectric, Maxwell called a *Displacement Current*.

When a condenser is being charged, the directions of the charging current and the displacement current are the same, so that

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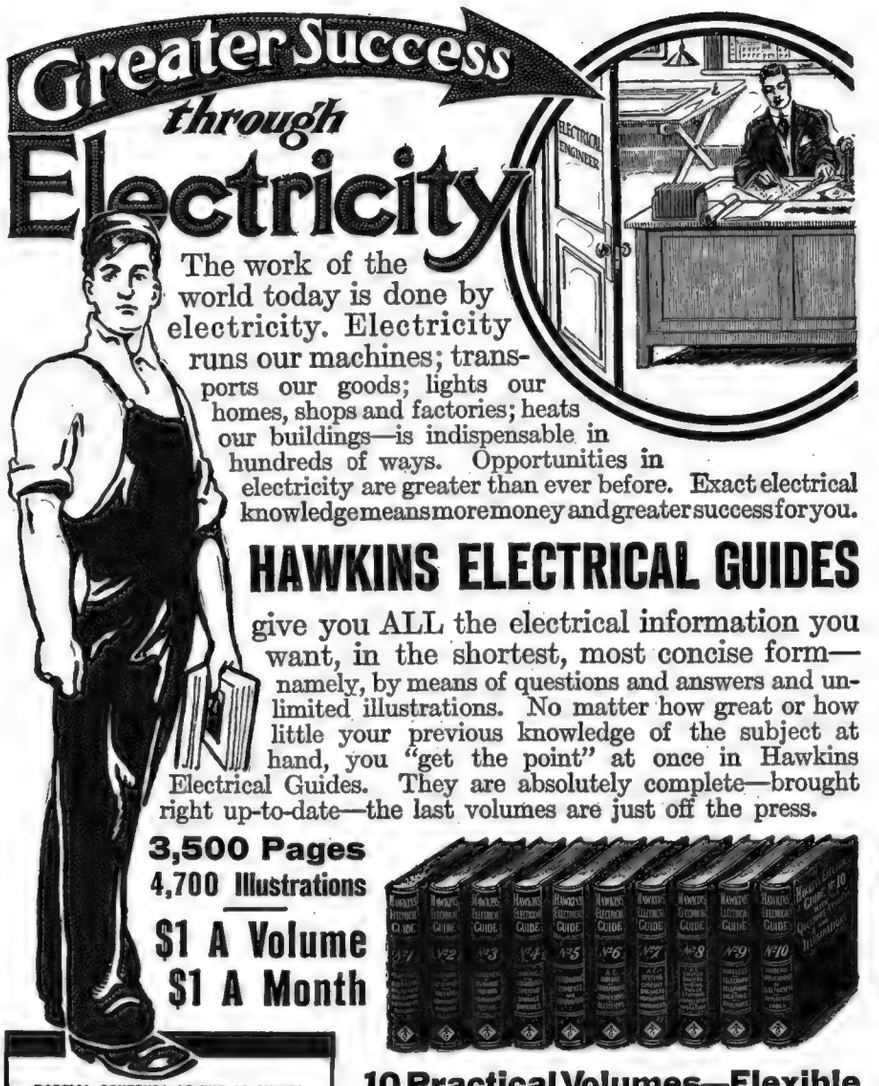

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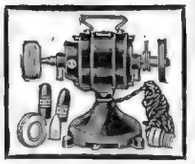

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the electrical circuit may be said to be completed thru the condenser by the displacement current. At discharge, Pierce states that the dielectric loses its polarity and gives rise to a displacement current in it. Like the action of discharging, the action of the displacement current completes the circuit for the discharging current.

High tension condensers for radio transmitting requirements are very often, especially for experimental sets, built up from a number of glass plates coated on both sides with oppositely charged metal leaves.

Referring to Fig. 3, it is at once apparent how the alternate metal leaves are connected to the opposite terminals T_1 and T_2. In constructing high voltage condensers in this way, it is always best to round off all the corners of the metal plates, so as to reduce the brush discharge to a minimum; and coating the glass plates with asphaltum paint will also reduce the brush or corona leakage, which becomes a considerable factor when the condensers are operated at very high potentials. If serious trouble is encountered in this direction, it behooves us to increase the insulation as much as possible, and this can be well taken care of by immersing the complete assembly of glass and metal plates in a glass or other jar containing a good insulating oil such as boiled out linseed oil or Transil oil. Paraffin oil is also used for this purpose. In calculating the capacity of condensers, it should be noted that it is only the *active dielectric surface* that counts, i.e., the area of dielectric (glass, etc.) covered *on both sides* with metal charging plates equals the effective length "l" times effective width "r." The thickness of the dielectric is represented at "d."

Some constructors prefer to mount the glass plates about one-half inch or so apart in a suitably grooved wooden frame, each glass plate having a tin or other foil leaf made fast to the glass by means of thin shellac or, better still, banana oil. The metal leaves are readily rolled down tight on the glass so as to squeeze out all air bubbles by means of a rubber print roller such as is used by photographers. Condensers most always break down at the point where air bubbles are present, hence, every precaution should be taken to eliminate them. Some have even gone so far as to sand blast the glass plate surface, and then, by suitably treating the roughened surface, to coat it firmly with a copper plate deposited electrolytically on it. The glass plates are usually coated first with a dressing of plumbago (grafite). Another method is to burn the copper or other metal directly into the glass surface by placing the glass dielectric in a suitable oven, in which the temperature can be raised to approximately or nearly the fusing point of glass.

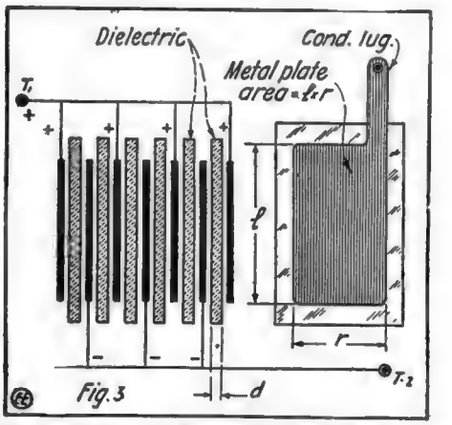
A set of direct-reading condenser capacity curves are given at Fig. 4, whereby it is possible to ascertain the required capacity of a condenser for all average sizes of experimental, radio transmitting transformers, and the formula by which these curves were calculated and plotted is given below so that the reader may compute the proper capacity for any special problem not covered by these curves. For instance, it is found that for a sixty cycle 1 K.W. step-up transformer, delivering ten thousand volts at the secondary, there will be required a high-tension, secondary condenser for the closed oscillating circuit, having a capacity of .165 microfarads. Knowing the required capacity of the condenser it is next necessary to select the proper number of glass plates and their sizes as well as their thickness. Generally speaking, it may be said that for amateur requirements it is usual to employ about 1/16-inch glass plates for potentials under 10,000 and ⅛-inch glass plates for potentials up to 18,000. This matter may be lookt into more precisely by referring to any electrical engineering handbook such as "The Standard Handbook for Electrical Engineers," wherein the dielectric strength in volts per mil is given for various insulators.

The curves given at the bottom of Fig. 4, enable one to compute the required *active area* of dielectric for the above or other capacities and the results will be found very close if the mf. per one square inch, as given on the various curves, is divided into the total mf. capacity required.

The ordinates at the left are for various *active dielectric areas* in square inches, coated on both sides with oppositely charged plates, and by reading from these values across to the dielectric curve and then from this point downward, the corresponding capacity in mf. will be found.

A résumé of the principal formulae involved in the calculation of condensers is given below.

The *farad* is the basic unit of capacity. It is that capacity resultant from 1 coulomb raising the potential of a condenser from zero to 1 volt. The farad is a relatively large unit and the *microfarad*, (the



How Condenser Is Built Up of Glass Plates or Other Dielectric, Separated by Oppositely Charged Metal Leaves

one-millionth part of a farad), abbreviated mf., or μf., is used for all ordinary purposes. The several sub-divisions of the unit of capacity in common use are as follows:

Microfarad = 10^{-6} farad (m.f.).
Milli-microfarad = 10^{-9} farad.
(Also called Billifarad.)
Micro-microfarad = 10^{-12} farad.
(Also called Picofarad.)
1 farad is equivalent to 9×10^{11} centimeters in electrostatic units.
1 microfarad = 9×10^{5} centimeters in E.S. units.

The formula for calculating the capacity of condenser is:

$$C = \frac{885\ K\ a}{d \times 10^{10}} \text{ (for cm. measurements)}$$

or

$$C = \frac{2{,}248\ K\ a}{d \times 10^{10}} \text{ (for inch measurements)}$$

Where: C = Capacity in microfarads.
K = Inductivity factor of dielectric. (See table below.)

a = Area of all the dielectric sheets *actually* between and separating the metal condenser plates.

Also a = number of insulating sheets covered on both sides by oppositely charged plates multiplied by area of each sheet.

d = thickness of dielectric sheet.

$10^{10} = 10{,}000{,}000{,}000.$

Condensers in parallel:

$$\text{Joint capacity} = C_1 + C_2 + C_3 + \text{etc.}$$

Condensers in series:

$$\text{Joint capacity} = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \text{etc.}}.$$

Series—Parallel condenser circuits:—Compute joint capacity of each branch (with condensers in series) and then compute joint capacity finally for the number of branches in parallel.

Computing energy in condensers:—
E=Volts across condenser terminals
C=Farads capacity of condenser
Q=Coulombs in condenser
Then:—$Q = C \times E$;

$$C = \frac{Q}{E}; \quad E = \frac{Q}{C}.$$

Capacity of rotary variable condenser.

$$C = \frac{2.248 \times (3.1416\ R^2 .5n) \times K}{d \times 10^{10}};$$

Where: R=Radius of movable plates in inches
N=Total number of air spaces *actually* between moving and stationary plates
d=Thickness of air space between a moving and fixt plate or
K=Being 1 for air, is here ignored except when oil bath is used.

Current taken by condenser on A.C. circuit:—

$$I = \frac{E\ C\ 2\pi f}{1{,}000{,}000};$$

E=Effective A.C. volts
C=Capacity condenser in microfarads
f=Frequency of charging current
$\pi = 3.1416$

Capacity of condenser required for different sizes of wireless transformers:—

$$C.mf. = \frac{K.W. \times 10^9}{V^2 \times f};$$ *(based on 2 sparks per cycle)*

Where K.W.=Secondary output of radio transformer in kilowatts. Transformers are generally rated in secondary output.
V^2=Sec. volts (effective) squared.
f=frequency in cycles of transformer primary current and based on 2 sparks per cycle or 1 per alternation.
10^9=1,000,000,000

For sets using a rotary spark gap:—

$$C.mf. = \frac{2 \times W \times 10^8}{N \times V^2};$$

Where:—W=Power in watts (sec. output)
N=Discharges per second from rotary gap
V^2=Volts (transformer secondary).

Inductivity Values for Different Dielectrics.

Dielectric	Inductivity Value, "K"
Air at Ordinary Pressure, Standard	1.0000
Manila Paper	1.50
Celluloid	1.555
Paraffine, Clear	1.68 to 2.32
Beeswax	1.86
Paraffine Wax	1.9936 to 2.32
Paraffined Paper	3.65
Resin	1.77 to 2.55
Petroleum	2.03 to 2.42
Hard Rubber (Ebonite)	2.05 to 3.15
Turpentine	2.15 to 2.43
India Rubber, Pure	2.22 to 2.497
Sulphur	2.24 to 3.84
Gutta Percha	2.46 to 4.20
Shellac	2.74 to 3.60
Olive and Neats-Foot Oils	3.00 to 3.16
Sperm Oil	3.02 to 3.09
Glass, Common (Low Frequency)	3.25 to 4.00
Glass, Common (Radio Frequency)	4.21
Mica Sheet, Pure	4.00 to 8.00
Porcelain	4.38
Quartz	4.50
Castor Oil	4.80
Flint Glass, Very Light	6.57
" " Light	6.85
" " Very Dense	7.40
" " Double Extra Dense	10.10

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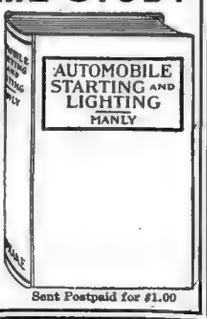

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EXPERIMENTAL CHEMISTRY.

(*Continued from page 746*)

gases being liberated from the solid compound, thus breaking it up into its elements.

USES.

The chief uses of nitrogen may be condensed as follows:—[a] In the manufacture of explosives; [b] for use as fertilizer; [c] in the preparation of Nitric Acid; and [d] in the manufacture of Ammonia.

EXPERIMENT NO. 31—

In the preparation of Nitrogen the operator must first consider which apparatus he is going to use in its preparation. Figs. 46 and 47 show two types of apparatus which may be used.

If convenient it is probably better to use the one shown by Fig. 47.

First bend a glass tube at right angles, about 4 inches on each bend. Next bend a tube in the same manner, but about 4 or 5 inches on the upper bend, and long enough to pass thru the safety bottle, after being connected to the tube from the Florence or Erlenmeyer flask. Bend a delivery tube in the same manner as Fig. 33 [November issue of THE ELECTRICAL EXPERIMENTER], and connect the balance of the apparatus as shown.

If the apparatus shown in Fig. 46 is used, all that is required is the delivery tubes, ring stand, and iron gauze. The balance of the apparatus is set up as shown.

To connect glass tubing by means of a rubber connector, slip the rubber tubing [which should fit snug] over the glass tube as shown.

Mix on separate papers, about 5 grams of Ammonium Chlorid [NH_4Cl] and 8 grams of Potassium Nitrit [KNO_2]. Put them in a Florence or Erlenmeyer flask and add about 20 or 25 cc., of water. Connect the delivery tubes as shown, and place a Bunsen burner under the tripod or ring stand. Fill up an 8 oz. bottle in the same manner as for the experiments on Oxygen and Hydrogen [described in previous articles]. After everything is connected, and the delivery tube is under the receiving bottle, apply a flame from the Bunsen burner, and carefully note and record any phenomena which occur. If the evolution of gas is too rapid, remove the burner, or pour water into the flask thru the thistle tube. It is advisable to reject the first portions of the gas, as it undoubtedly contains air which was present in the flask and delivery tubes. Collect the gas by the displacement of water in the same manner as for Oxygen and Hydrogen.

EXPERIMENT NO. 32—

After you have collected a bottle of gas, apply the splint test in the same manner as for oxygen.

Try to burn Sulphur in Nitrogen.

Record the results of burning substances when thrust in Nitrogen.

From your tests, can you state whether nitrogen is a supporter of combustion?

EXPERIMENT NO. 33—

Make a small hole, about ⅛ inch deep and ⅛ or ¼ inch in diameter, in an end of a piece of ordinary blackboard chalk. Next coil some No. 16 wire around it and pass the free end thru a cork which is larger than the mouth of the receiving bottle, shown by Fig. 48. The cork must be weighted so that it rests firmly on the bottom of the pan or basin.

Take a small piece of Phosphorus by means of a pair of forceps [see Note], about the size of a pea, and roll it on a piece of filter paper to remove any water. Then quickly place it in the hole in the chalk. Heat the end of a triangular file in the flame of the Bunsen burner, and touch the end of the phosphorus with it. Immediately cover the cup with an inverted bottle, which must be held in either hand for immediate use; see Fig. 49. All the above operations should be performed rapidly, but at the same time care must be taken to follow the instructions accurately. If the phosphorus does not ignite, the operations must be repeated.

[NOTE:—Phosphorus must be handled with great care. When selecting a piece for use in an experiment, always do so with a pair of forceps; never allow it to come in contact with the skin. Again, after you have taken a small piece from your stock, always replace the latter under the water in the container and replace the stopper at once. Never allow it to remain out of the water or uncovered. Be very careful that you do not allow it to drop, or remain in the air for any considerable length of time. When you have used the forceps to handle phosphorus, always burn the remaining particles which adhere to it in the flame of the Bunsen burner. In other words handle phosphorus with care, the same as you would Metallic Sodium or Potassium.

After the white cloud in the bottle has subsided, remove the stand which contained the phosphorus from under the bottle [keeping the bottle of gas under water all the time, and taking care that no air is allowed to enter], and slide a glass plate over the mouth and remove. Set the same on the work table and apply the splint and other tests described in Experiment 34.

EXPERIMENT NO. 34—

Apply a lighted splint to the bottle containing the Nitrogen and notice if the results are the same as those obtained in Experiment 32.

Introduce some burning sulphur by means of a deflagrating spoon. Notice and record your results.

When the phosphorus was burned in the air in the bottle, the oxygen combined with it, producing dense white fumes [Phosphorus Pentoxid, P_2O_5], which in turn gradually subsided and finally dissolved in the water, leaving the receiver about four-fifths full of Nitrogen.

$$\underset{\text{Phosphorus}}{2P} + \underset{\text{Oxygen}}{5O} = \underset{\substack{\text{Phosphorus}\\\text{Pentoxid}}}{P_2O_5}$$

The reason why this method is better than most substances is because it burns or combines with Oxygen very easily; because the compounds which it forms with Oxygen [the product of Combustion] is a solid and dissolves in the water. If the product of combustion were a gas, this would remain mixed with the Nitrogen after the combustion.

ELIHU THOMPSON AWARDED THE "JOHN FRITZ" MEDAL.

Professor Elihu Thomson, past president of the American Institute of Electrical Engineers, and one of the foremost electrical engineers and physicists of America, was presented with the "John Fritz" medal for *achievements in electrical inventions, in electrical engineering, and in industrial development and in scientific research,* at Boston, Mass., December eighth, the affair concluding the Three Hundred and Twenty-seventh meeting of the A.I.E.E. The exercises were held in the central lecture hall of the Massachusetts Institute of Technology, at Cambridge. Professor Thomson was but recently the recipient also of the "Hughes Medal" of the Royal Society of London *for investigations in experimental electricity.* Among the recipients of the "John Fritz" medal have been John Fritz, Lord Kelvin, George Westinghouse, Alexander Graham Bell and Thomas Alva Edison.

The principal address of the evening was made by E. W. Rice, Jr., president of the General Electric Company, who has been closely associated with Dr. Thomson for over thirty-six years.

PATENT ADVICE

Edited by H. GERNSBACK

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

AUTOMOBILE LAMP.

(121.) A. Anderson, Laurium, Mich., asks for advice on a searchlight constructed in such a manner that it allows for better focusing of the light. The searchlight is made on a telescopic plan in order to move the front lens backward and forward.

Answer. The idea is not a new one and while a patent might be obtained upon it, we do not see where the device fills any necessary want, and we think our correspondent would find it hard to convince manufacturers that they should adopt the idea.

CONTINUOUS ENVELOPE.

(122.) John W. Geiger, Clinton, Ohio, submits for our consideration and advice, an idea which he conceived in the construction of mailing envelopes, so joined together that they will be neatly placed upon a roll easily attached to the carriage of any typewriter, being folded from one continuous sheet of paper. The idea is to save time consumed in removing and replacing envelopes by operators in large houses that have extra large mailing lists. The operator need give the carriage but a single turn to bring the next envelope in place, and a person standing at the rear of the typewriter could fill, seal and detach envelopes as they come off machine. We are asked if we think the idea practical and whether a patent should be applied for.

Answer. This is really a capital idea and one of the best things of its kind we have seen lately. We are quite certain that a patent could be obtained on this idea and we are furthermore positive it fills a distinct want. This is the kind of patent that should make good money for its inventor.

INVISIBLE PERISCOPE.

(123.) Millis Knickerbocker, New Lenox, Ill., writes as follows:

"In a recent number of THE ELECTRICAL EXPERIMENTER there is an article in which Edison is quoted as asking or suggesting that some young inventor invent an *Invisible Periscope*. That reminds me of some experiments I have tried that might be developed into an *Invisible Periscope*. I ask your opinion as to practicability. By using a concave, clear glass reflector, the intercepted rays that are always reflected no matter what kind of glass is used, could be collected and condensed on a plain reflector strong enough to answer the purpose. The clear glass used would practically be invisible. What would you advise?

Answer. The trouble with this idea is that the periscope would still be visible for the concave glass reflector would have to be mounted upon some sort of metallic structure which would leave just as much of a *water trail* as the ordinary periscope. Frankly, we do not think the idea is practical at all.

PHOTOMETER.

(124.) John T. Dwyer, Philadelphia, Pa., submits drawing and plan for determining the candlepower of electric lights and desires our opinion as to patentability, etc.

The device employs the well-known principle of the selenium cell's susceptibility to light, when the rays from the lamp to be tested are focussed on the cell, there is a corresponding increase or decrease according to the brilliancy of the former, and the current set up actuates the gaging instrument in proportion. Several other ideas are shown in the device.

Answer. There is nothing new shown in the idea and we doubt very much if a patent could be obtained. Selenium cells are not reliable enough for fine photometric purposes, nor do they always register the same resistance. They deteriorate at a time when fine calculations are to be made and they are not reliable enough, and herein lies the greatest weakness.

INTERFERENCE PREVENTER.

(125.) J. P. Merrill, Buffalo, N.Y., claims to have invented and perfected a practical and efficient *Interference Preventer*, which will make it possible for two stations to talk while a third cannot listen in. He desires our advice on the idea.

Answer. There does not seem to be anything new contained in the idea and it, moreover, seems to have been described in one form or another frequently during the past three years in the scientific press. We do not encourage anyone to work on this idea.

TOY MOVING PICTURE MACHINE.

(126.) William J. Cherry, Jr., Rock Hill, S.C., has submitted to us the description of a toy moving-picture machine which is to be hand-operated and which is supposed to use standard film. Our advice is asked on the idea.

Answer. As the idea is worked out on the sketch submitted to us, we do not think much of it; such an oufit is too crude. There are quite a few toy moving-picture machines on the market selling as low as $5, and we would advise our correspondent

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to get some of these and look them over before spending much time on the new device.

CROSS-CUT SAW.

(127.) Roger Hackney, Wellington, Kans., wants advice as follows:

The first idea describes an automatic cross-cut saw and this machine automatically cuts into certain lengths, boards, strips, mouldings, etc., which are fed into it. It can also be used in furniture factories for cutting chair legs for instance out of strips of the proper sizes fed into it and the action of the machine is entirely automatic.

Answer. This is an excellent idea and will certainly do away with a large amount of expensive labor and we see no reason why this machine does not work exactly as our correspondent states. We think a patent can be obtained upon it.

The second idea submitted shows an automatic cap for collapsible tubes for toothpaste, etc.

Answer. While no doubt a patent could be obtained upon the device described by our correspondent, we are afraid that the manufacturers would not take to it kindly as we do not think the device is practical enough. Also the spring part seems to be too much in the way tending to make the article more or less cumbersome.

ELECTRICITY, THE WONDER DOCTOR OF THE AGE.

(*Continued from page 766*)

ally operated machine being given here. The Doctor explained that the Arthromotor—the invention of the famous Swiss surgeon, Dr. Charles Scholder—had been in use for more than six years, and had proved so extremely satisfactory, and the uses for it have increased so rapidly, that a second Arthromotor had been added more than four years ago, and *these are the only instruments of their kind in the United States.* Five hundred cases of stiffened joints and muscles have been successfully treated with the Arthromotor.

Briefly explained, the Arthromotor consists of a universal, interchangeable mechanism composed of various levers and gears coupled up to an electric motor and so calibrated and so precisely arranged that any limb or section of a limb can be repeatedly and rapidly manipulated. Not only this, but each motion of the manipulating mechanism can be gradually augmented or made greater in amplitude from day to day upon each visit of the patient. The illustration here reproduced shows a patient with his body placed in a horizontal position for easy flexion of the hip joint.

As we entered the rooms allotted to the obesity reduction department, there were several patients undergoing treatment in an effort to become thinner and more sylph-like in form. First we were shown the *Niles normalizing machine,* illustrated above, the patient resting comfortably on a mattress while electrically driven belts, lined with wooden bars, repeatedly oscillate back and forth over the fleshy part of the body. Several oscillating belts may be applied simultaneously as becomes apparent.

Fat folks are especially liable to hardening of the arteries, dropsy, skin eruptions, diabetes, asthma, apoplexy, gall stones and gout. They stand operations poorly and lack resistance to acute infection. They are very prone to anemia and conditions resulting from lack of red cells in the blood.

The old method of obesity reduction was one of hard work and self-denial. Rolling on the floor, crawling, stretching, stooping, twisting and turning, galloping on all fours, "picking pins," high kicking and severe dieting. But the number of fat folks who got

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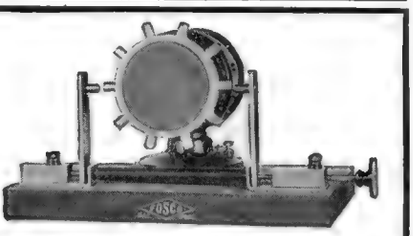

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results by all or any of these ways was too small to be considered.

One of the most ingenious and scientifically designed obesity obliterators—the Bergonié apparatus* (see illustration)—was finally inspected. This device is mostly electrical in nature and employs a special switch-board containing an interrupter which gives a current of peculiar wave form and time periodicity. This current is past thru the patient's body while weights in the form of sand bags are placed upon the body or any certain part of it. In other words the Bergonié machine induces electrically and automatically proper physical exercise in such fatty portions as may be treated.

The Bergonié apparatus has the remarkable attribute of evoking *painless muscular contraction* and without the expenditure of any energy—muscular or nerve—on the part of the patient. So its employment as a means of developing weak abdominal muscles, the groups of muscles in scoliosis, paralyzed muscles in cases of hemiplegia and infantile paralysis, was most natural and the results have been very gratifying and lead to a more extended application of this powerful passive exercise. Thus the day of the fat man—or woman—is, or is not, depending upon how you feel about it. Of course this does not hold if you tip the scales at somewhere between one hundred and two hundred pounds!—*Photos courtesy Sprague Institute.*

See July, 1914, issue this journal, p. 35.

NEW NORWEGIAN WIRELESS STATION.

A new wireless station, the erection and equipment of which represent an amount totalling $110,000, is being erected by the Norwegian government at Oorsater. The station, which will have masts 300 feet high, is intended for communication with the large Europea- wireless stations. It is also proposed to erect a small station for shipping. It is expected that the new station, which will be equipt on the same principle as that at Nauen, near Berlin, and is being erected by a German company, will be ready for operation shortly.

ELECTRIC POWER FROM OCEAN WAVES.

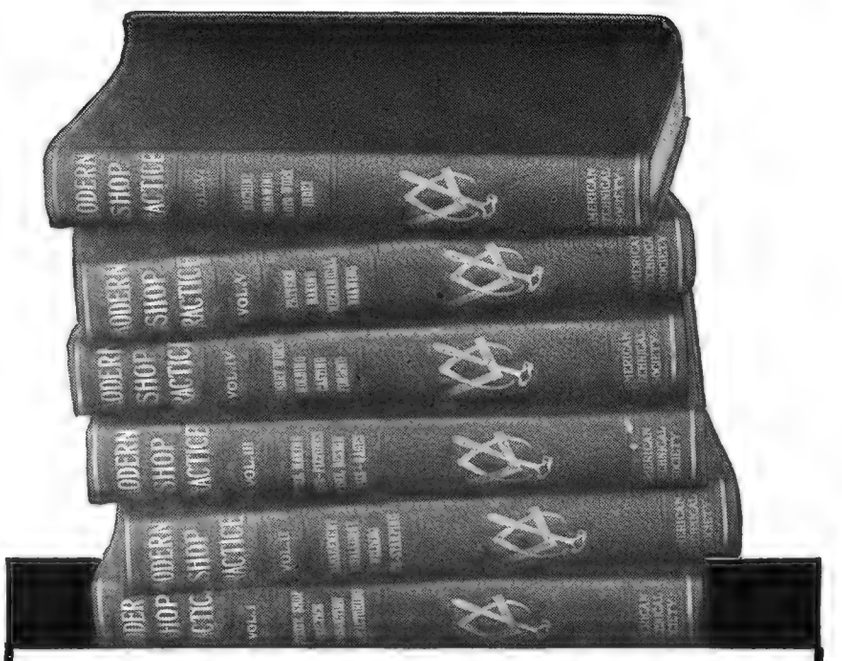
(*Continued from page 715*)

are mounted so as to transmit their *energy producing* power thru substantial ratchet wheels and pawls and the downward motion of the floats will thus cause the pinions to simply slip around on their shaft without exerting any turning effort upon it.

The inventor of this interesting wave motor plant has arranged for the rotation of the upper power room section by means of a manual or motor operated rack and pinion as the reader will observe. The tower structure rests on a ring of coned roller bearings and thus the circular power structure carrying the float arms and their supports, can be arranged to automatically (or manually) swing round about the vertical axis of the tower so as to utilize the wave energy to the best advantage.

The lower central steel tank on which the tower rests is made air-tight and is therefore, of course, buoyant. In most cases the predominant or greater weight of the tower structure as compared to that of the floats and their reaction power, would be such as to cause the tower to rest quite steadily, or sufficiently so for the float arms to move up and down and to transmit their power to the main pinion shaft in the manner illustrated and described.

The inventor has, however, provided that, where necessary, suitable raising and lowering apparatus may be installed in the lower portion of the tower structure which can



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be automatically controlled by the rise and fall of the tide. With the base structure of the tower made air-tight so as to be buoyant, the tower will retain the proper level in the water automatically as the tide rises and falls; but this may not be satisfactory in all cases.

Regarding the power of ocean waves, there have been a number of computations made on this important basic quantity.

Mr. Albert W. Stahl, U.S.N.,* has given us the following formulae and table, based upon a theoretical discussion of wave motion:

The total energy of one whole wave length of a wave H feet high, L feet long and one foot in breadth, the length being the distance between successive crests and the height the vertical distance between the crest and the trough, is:

$$E = 8LH^2\left(1-4.935\frac{H^2}{L^2}\right) \text{ in foot-pounds}$$

The time required for each wave to travel thru a distance equal to its own length is

$$P = \sqrt{\frac{L}{5.123}}$$

seconds, and the number of waves passing any given point in one minute is

$$N = \frac{60}{P} = 60\sqrt{\frac{5.123}{L}}$$

Hence the total energy of an indefinite series of such waves, exprest in horse-power per foot of breadth is:

$$\frac{E \times N}{33{,}000} = 0.0329\frac{H^2L}{\sqrt{L}}\left(1-4.935\frac{H^2}{L^2}\right).$$

By substituting various values for H ÷ L, within the limits of such values actually occurring in nature, the following table is obtained:

Total Energy of Deep-Sea Waves in Terms of Horse-Power Per Foot of Breadth

Ratio of Length to Height of Wave	Length of Waves in Feet							
	25	50	75	100	150	200	300	400
50	0.04	0.23	0.64	1.31	3.62	7.43	20.46	42.01
40	0.06	0.36	1.00	2.05	5.65	11.59	31.95	65.58
30	0.12	0.64	1.77	3.64	10.02	20.57	56.70	116.38
20	0.25	1.44	3.96	8.13	21.79	45.98	120.70	260.08
15	0.42	2.83	6.97	14.31	39.43	80.94	223.06	457.89
10	0.98	5.53	15.24	31.29	86.22	177.00	487.75	1001.25
5	3.30	18.68	51.48	105.68	291.20	597.78	1647.31	3381.60

The figures are correct for trochoidal deep-sea waves only, but they give a close approximation for any nearly regular series of waves in deep water and a fair approximation for waves in shallow water

The question of the practical utilization of the energy which exists in ocean waves divides itself into several distinct parts, viz:

1. The various motions of the water which may be utilized for power purposes.

2. The wave motor proper. That is, the portion of the apparatus in direct contact with the water, and receiving and transmitting the energy thereof; together with the mechanism for transmitting this energy to the machinery for utilizing the same.

3. Regulating devices, for obtaining a uniform motion from the irregular and more or less spasmodic action of the waves, as well as for adjusting the apparatus to the state of the tide and condition of the sea.

4. Storage arrangements for insuring a continuous and uniform output of power during a calm, or when the waves are comparatively small.

The motions that may be utilized for power purposes are the following:

1. Vertical rise and fall of particles at and near the surface.

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2. Horizontal to-and-fro motion of particles at and near the surface.

3. Varying slope of surface of wave.

4. Impetus of waves rolling up the beach in the form of breakers.

5. Motion of distorted verticals.

All of these motions, except the last one mentioned, have at various times been proposed to be utilized for power purposes; and the last is proposed to be used in apparatus described by Mr. Stahl. His paper contains illustrations of several wave-motors designed upon various principles. His conclusion as to their practicability is as follows: "Possibly none of my methods may ever prove commercially successful; indeed the problem may not be susceptible of a financially successful solution. My own investigations, however, so far as I have yet been able to carry them, incline me to the belief that wave-power can and will be utilized on a paying basis.*

Still another phase of the utilization of tidal or natural water power was described and proposed some years ago by Mr. P. Decoeur. This involved the employment of huge basins or reservoirs in connection with the tidal action in the estuary of the river Seine, France. The germal idea was to use two basins separated by a bank rising above high water, within which hydraulic turbines would be placed. The upper basin would be in communication with the sea during the higher one-third of the tidal range, rising, and the lower basin during the lower one-third of the tidal range, falling. The turbine proposed is of an improved model designed to utilize a large flow with a moderate diameter. One has been designed to produce 300 horse-power, with a minimum head of 5 ft. 3 in. at a speed of 15 revolutions per minute, the waves having a 13-ft. internal diameter. The speed would be maintained constant by suitable regulating sluices actuated automatically. The sea would thus be caused to render useful services to man, as the rise and fall of the tide filled first one large basin and then the other. It is a case of lifting a large quantity of water to a higher level, giving it potential energy, which causes it to seek a lower or natural level as thru a series of hydraulic turbines connected to electric dynamos.

*For further details see Transactions of the American Society Mechanical Engineers, XIII, 438 and Kent's Mechanical Engineer's Hand-book. 1916 Edition.

ELECTRIC SIGN TO WARN RIVER BOATS.

Three signs, the central one to be illuminated by electricity at night, are to be erected on the upstream side of the Big Four bridge over the Ohio River at Louisville. This bridge is about a mile above the head of the rapids at Louisville and the signs will warn water traffic bound downstream of the danger immediately below.

ENGLISH WOMEN LEARNING WIRELESS.

British women are being trained in wireless operation. Almost a year ago the Marconi organizations in England determined to test the suitability of women as wireless operators, and establish a school at one of their stations, where instruction of a practical and theoretical nature has been given to women. The school has been well attended. So far as it has gone the experiment is regarded as encouraging, and some of the pupils have been already drafted to stations, where they are taking night duty in turn with men. The criticism has been made that sending by female operators has a tendency to be too light. This defect varies in individual cases, however, and many of the women learners, it is thought, will become efficient wireless operators.

DR. NIKOLA TESLA AND HIS ACHIEVEMENTS.

(*Continued from page 713*)

operated; it being possible to throw them in and out of tune by a variation of not more than one thousandth of one per cent of the wave length. He has also evolved a *static preventer* which has been successfuly tested several years ago. He is at present engaged in preparing these instruments for the market.

This great scholar and philosopher has not devoted his time to electrical devices alone, but recently turned his attention to a new form of prime-mover, which will develop more power than any other motor or engine, and he has stated that it is within the limits of practicability to develop 20 horse-power for each pound of engine weight. The Tesla turbine is shown in Fig. 7. It consists simply of a number of flat steel discs properly balanced. At the lower end of the case an inlet is situated thru which steam or comprest air is forced at a pressure of 100 to 200 pounds per square inch. The steam does not exert pressure against the rotor blades sidewise as in other types, but shoots thru between the blades edgewise. The velocity of the moving steam jet and the peculiar frictional effect resulting is sufficient to rotate the turbine spindle and blades at high speed and with unprecedented torsion or turning effort in foot-pounds. This machine herewith illustrated develops 200 horse-power, and there is no reason why such a machine could not be employed for drawing automobiles, aeroplanes and other vehicles, due to its marvelous simplicity and extreme lightness of construction.

It is further understood that he is perfecting a turbo-driven generator for high frequency currents to be used chiefly in radio-telephonic work. It will be very small, compact and entirely reliable, and will no doubt revolutionize wireless telephony.

This master magician of modern electrical science has spent a fabulous amount of time and money in perfecting his inventions, and we are bound to await with great expectancy the next great stride in scientific development which will mark another epochal invention of Dr. Nikola Tesla.

TUCKERTON RADIO AGAIN IN COURT.

In defending proceedings before Vice-Chancellor Stevens in Newark, brought by a French company to enforce its contract to purchase the wireless station at Tuckerton, N.J., the German company now in possession argued that the French company's only purpose is to embarrass Germany.

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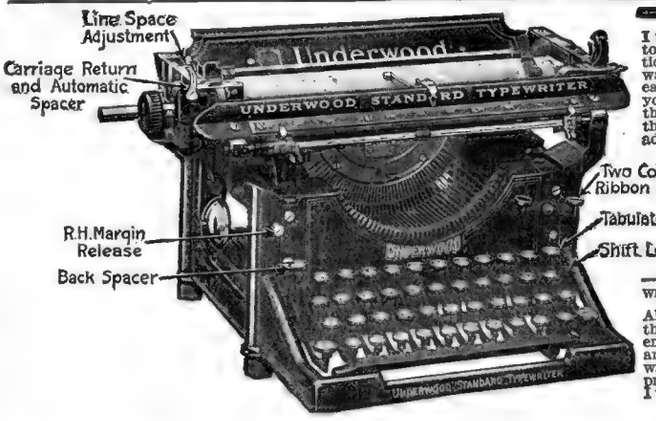

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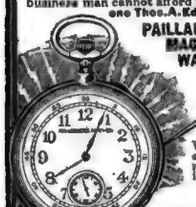

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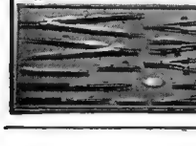

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WHEN ELECTRICITY PUTS OUT THE FIRE.

(*Continued from page 717*)

water per minute, or 72,576,000 gallons every twenty-four hours at 300 pounds pressure per square inch.

The instant the fire alarm sounds one pump is put into operation and the pressure in the mains raised to 125 pounds per square inch, which is sufficient to fight an ordinary fire. If so much water is required that the pressure begins to drop, then a pump is started in the other station.

These stations are connected with the regular fire alarm system and until an alarm is sounded, either in one district or the other, the pumps are still, the only pressure in the mains being the normal Croton pressure of about thirty pounds to the square inch. Electric power for driving the pumps is supplied by the New York Edison Company direct from the Waterside generating stations and to whom we are indebted for this data on the high pressure system. Each pumping station is connected with eighteen Edison sub-stations and by duplicate lines to the 150,000 H.P. Waterside central station. In addition there are independent reserve feed lines. As a bond of never-failing service the Edison Company is pledged to forfeit *$400.00 for every minute* of interrupted service after the current shall have been cut off for three consecutive minutes!

Not only is electricity king in the modern stationary pumping station, as we have just learned but it bids fair to inaugurate a new era in mobile fire-fighting apparatus. Just recently the speed, power and flexibility of electrically driven fire apparatus were well demonstrated in a test made at Paterson, N.J.

A combination chemical engine and hose wagon with its crew of fourteen men and an aerial ladder truck with its crew of twenty-two men were used for the demonstration (see illustrations herewith). The two pieces of apparatus were both converted horse-drawn trucks and were equipt with Exide storage batteries.

In the first test both trucks ran up an 18.23% grade, the first in 1 minute 13 seconds and the second in 1 minute 18 seconds. On climbing this hill a second time both trucks were stopt in the center of the steepest part of the hill and then run to the top at the same speed as before. In another test on another hill, also over an 18% grade, both trucks negotiated the hill in 1 minute and 20 seconds, the best previous time made on this hill being over 2 minutes. In a further demonstration a speed of 30 miles per hour was maintained on a level stretch of about one mile.

An electrically driven fire engine has been in constant service in Brooklyn for nearly five years. The New York Edison Company has kept complete records of its performance. The first official test of this novel equipment was held a few days after the engine had been delivered to the city. A six-mile run has been made thru the streets of Brooklyn, and the actual running time was twenty-three minutes, including the time of delays at street-car crossings and the slow progress made in Brownsville, a crowded tenement district. Over some parts of the distance, where the roads were clear, a speed of twenty miles was attained. The hill climbing tests were made on the famous Bedford Hill, a stretch seven-eighths of a mile long. Two trials were made, the first being timed at 2:37 and the second at 2:35.

This fire engine was originally a horse-drawn affair. To make the change, the builders removed the front wheels, the axle and pulling gear and substituted two Couple-Gear freight wheels, each of which contains an inbuilt three-horsepower electric motor, mounted on a special axle. This was attached to a frame thru which runs the steering gear, and which carries an 80-cell storage battery and the controlling apparatus. Otherwise it remained a standard fire engine as far as its pumping and fire-fighting qualities were concerned.

In a year's test, during which every feature of its operation was closely watched and carefully recorded, this engine, No. 217 of the New York Fire Department, has demonstrated the economy of *storage-battery driven* over *horse-drawn* apparatus. To be exact, it cost the city just $388.74 to maintain this *horseless fire engine,* as compared with the $655.26 that it costs to care for a team of three horses to haul the same machine.

To reconstruct the engine cost the department $4,000 and the apparatus at the end of one year's service was estimated to have a life of twenty years; so, figuring on a five per cent basis, $200 a year is allowed for depreciation. Added to this is the cost of battery charging, the rate being six cents per kilowatt hour; 1,965 kilowatts were used in responding to a year's fires, so the current bill amounted to $117.90. Distilled water and sulfuric acid for new electrolyte, brushes for the motors and other repairs added $70.84 to the bill, bringing the total cost for twelve months' operation to $388.74.

Three fire engine horses, their harness, the hangers and the ceiling apparatus for dropping it over their backs costs the department $1,059.75, and new animals and equipment are required every ten years making the item for depreciation $105.98. It costs $410.82 to feed three horses, horse-shoeing costs $85.04 and veterinary service $21.00, and added to this are $32.42 for sundries, bringing the total cost $655.26.

These figures show a difference of $266.52 between the two types of motive power. During this particular year the electric engine went to more than three hundred fires and the bill for "feeding" the storage batteries was but $117.90. Had there been but *one fire,* the "feed" bill would have been in the neighborhood of *thirty cents!*

And it's still a long way from the scrap heap, for with the exception of battery renewals and replacement of minor parts, it stands to-day just as it did when it went in service on April 24th, 1912. The bills for repairs and renewals for two years' service came to just $744.29; $486.97 of which was the battery renewals that were made after the machine had been in service a year and a half. The balance includes minor parts, labor and decorating, for the engine was entered in two street parades. Adding depreciation and the cost of charging, the operation of this engine cost the city just $1,370.03 for two years.

The cost of motive power for this same type of engine, but with horses instead of a storage battery, is $1,469.06 for two years. These figures are based on the records of two companies which ordinarily respond to about the same number of calls as No. 217. The sum includes depreciation on horses and harness and stable equipment, which at ten per cent is $105.98 a year. Feed, shoes and veterinary service for three horses cost $516.86, while the repairs vary. So we see that the "electric" fire engine is indeed a reality which threatens to assume large proportions as its many worthy features become better known. One thing is certain—it rarely ever balks, something which cannot be said of its rival, the gasoline propelled truck.

Photos courtesy New York Edison Company and Electric Storage Battery Company.

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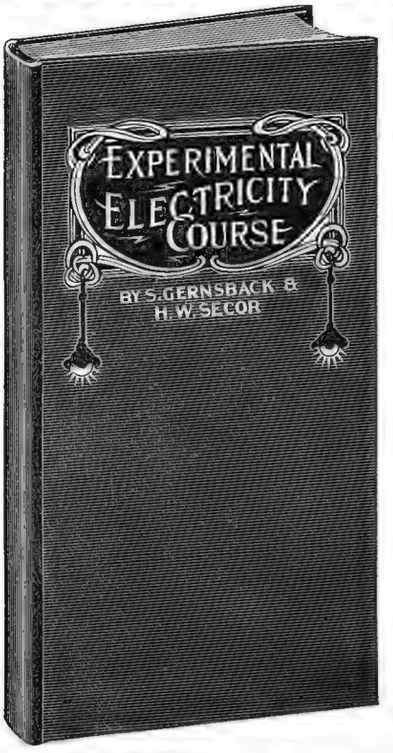

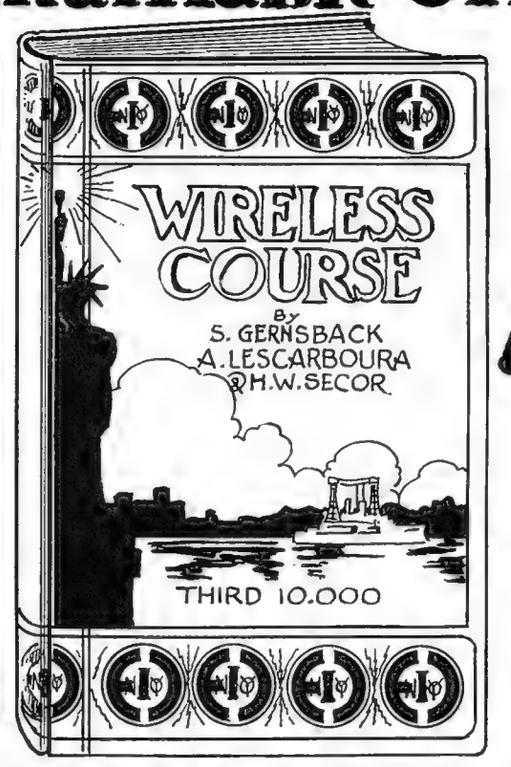

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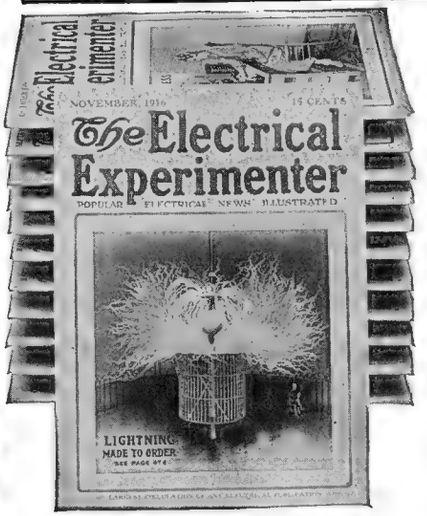

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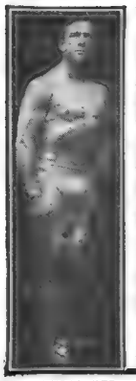

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RESEARCH AS A NATIONAL DUTY.

(Continued from page 723)

forts, and the health of our people, depend upon the rate of our acquirement of new knowledge, there ought to be much greater effort made along the lines of research than is at present the case.

"We call knowledge power, but we need to see that new knowledge is like a second power to power.

"I'd rather be a little Moses than a big Jeremiah. I'd rather point a way to a promised land, however remote, than talk about our lamentable conditions. But we Americans are not entirely imbued with the spirit of active and efficient service. We are a preliminary experiment on the possibility of operating a competitive nation in a democratic manner, but we don't care much about it. We have about as little interest in the wonder and elasticity of nature, the laws of materials (except where they affect our stomachs and our health) as had Darwin's starving Patagonians. With us the spirit of the hive is confined to the bees. Germans and Japs make better scholars than we do, and a Chinese laundryman sticks longer to his daily job and talks less about it. We are living in the Garden of the Gods, but we are still eating grass.

"I do not think due reverence is given to new knowledge. I want to illustrate. Some time, somewhere, centuries ago, the slag of a fireside appeared transparent, some one tried to learn more about it, and so, ultimately, glass was made. Research is still under way on that very material, and countless numbers of men have added to the knowledge. Glass has kept the cold from the house. It has let in the light. It has renewed our eyes as they have worn out. Through telescope and microscope it has shown us the greatest and the smallest things of the universe. It has bottled our drinks and held our lights. Every year still adds new service, just in proportion as experiments add new knowledge of glass. To-day we hear of new glass permeable to ultra-violet light, glass opaque to X-rays, and glass for cooking utensils. Not one of these little increments will ever be lost, but will continue in use, so how highly should we value them? Why did we delay so long in coming thus far, and how far or fast may we still go?

"Research presents a way, and the only certain one, of insuring peace, of preparing successfully for defense, and of being successful in war. It is the lasting, undeviating factor which has always dominated. This may sound bold and entirely inconsistent in itself. It is all true. Can we learn to see it? From the military expert to the anthropologist, thinking men recognize that for over 100,000 years war has been almost continuous on the earth. The inventors of chipped flint successfully fought those inferiors who had not experimented with flint. There were then no better arms. These also got their game even when it was scarce and other means failed, and so they continued to survive. This little and early example of survival was repeated a great many times before our present complex world conditions were reached, and will as surely continue to be repeated. The fundamentals were always the same. A 42 cm. gun is only a better flint. Trinitrotoluol is only a more modern sling. Arms and ammunition have changed, but just so have also changed the myriads of other important accessories to survival. This is the important point. Good guns go with good clothes, and niter is used in both fertilizers and in guncotton. The signs that we are improving in our civilization will also indicate that we are growing in our powers of national defense, but this should come rather as a consequence than as an object. And we Americans must not stand still. The world has always been improving, and the real growth and development has come to those nations which have been responsible for the original research work and not for the mere storage or conservation of the knowledge.

"One of the great needs of the country which reflects on us chemists and calls for immediate research is that for American potash. There is no supply in sight which is nearly comparable with the German deposits, and our fertilizer and other industries will certainly suffer because of this deficiency. We have plenty of feldspar calling for a simple process for removing the potash it contains. We have oceans of sea water carrying plenty of potash, if we knew how to extract it. Don't say it can't be done, for it is already done by miles of seaweed. Why should we confine ourselves to trying to take it away from the seaweed, instead of learning what the seaweed knows about getting it from the water? You will look supercilious, but until a large number of chemists have studied semipermeable membranes, there will always be this lack of understanding of those simple reactions of living matter going on around us. There will always seem to me a possibility of doing such physical and chemical processes more nearly as we may wish to do them when we know how these operate.

"When nothing new is being done by us it will be a sure token of our decay. When we stop increasing our experimental activities or fall for a considerable time behind the activities of other countries, we may expect to see our light become merely a memory, like that of Greece or Rome. Thus far we Americans have not reached a fair average as investigators in natural sciences, and yet we have incomparably superior conditions for the growth of research. I cannot look beyond the period when research shall cease in a country and still imagine that country a power in the world.

"It seems to me that our American colleges have been shortsighted in this respect. This may be explained by the rapidly increasing demand in our growing industries for analytical chemists and chemical engineers, who could at once meet the existing industrial requirements. This demand has kept the chemical departments of our colleges and technical schools very busy with the elementary and analytical side of chemistry and left little room for the synthetical or experimental side. It has also naturally tended toward the development of highly efficient organizations, equipments and corps of instructors for the preparation of the one type of chemist, but this very success seems frequently to make impracticable the training of men for research. The conscientious American professor has usually devoted his life to bringing his students up to a certain promising stage of interest in science and experiment, only to see them scatter before they have had any experience with questioning nature, or have tried any unbeaten chemical byway.

"While I am greatly interested in what might be done for science by technical research laboratories in the industries, I am sure that the university must be the important factor in guiding the pioneer work if we are to be a sufficiently advancing nation.

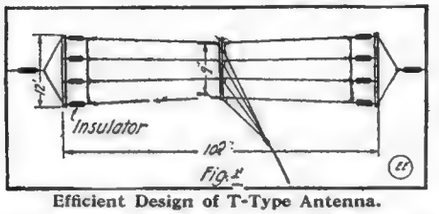
"The time when we are called upon to act in the field of the world's affairs is *now;* but it was yesterday, and it will be to-morrow. I maintain that no nation can effectively act in that field at odd or selected moments. It is either doing it much of the time, or it is likely to be unable to do it any of the time."

A LOW POTENTIAL ARC TRANSMITTER FOR RADIO STATIONS.

(*Continued from page 734*)

er shorts the anchor-gap when the key is deprest. This latter one should close slightly in advance of the former.

Before endeavoring to *tune up*, a device must be arranged to protect the 110-volt line from high frequency surges caused by the condenser discharging back into the

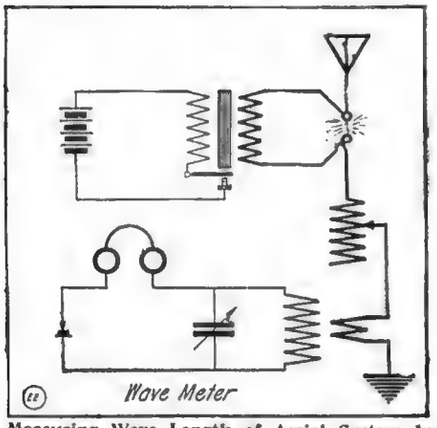


Efficient Design of T-Type Antenna.

power main. When using 500 volts to charge the condenser there is, however, little reason to fear dangerous kick-back discharges.

Do not use telephone condensers as means for preventing *kick-back*. The only *real safe* way is to bridge two high resistance carbon graphite rods, each about 1,000 ohms resistance, in series across the power terminals and connect a ground wire between the two.

To the average wireless enthusiast the problem of adjusting his sending instruments properly is not always clear. To do this correctly, tune the open oscillatory circuit to the desired wave length; then get the closed oscillatory circuit in resonance with the open one.



Measuring Wave Length of Aerial System by Exciting it With Spark Coil.

The aerial described here is adapted for a 200 meter wave length, providing there is the proper amount of inductance in the secondary of the oscillation transformer.

This can be found by the use of a wave meter placed in inductive relation to the ground. A spark coil with a straight gap in series with the aerial is used for an exciter (Fig. 5). Now the wave meter is set for 200 m. and by varying the clips on the secondary of the oscillation transformer the open oscillatory circuit is tuned to resonance with the wave meter.

The variable condenser and oscillation transformer primary are adjusted until the maximum amount of power is registered in the hot wire ammeter. Now we know our set is in resonance and also that we are transmitting on 200 m.

Just one thing more. The law reads that at all stations the logarithmic decrement shall not exceed .2. However, using the arc described here, there is little need to worry about decrement, even if tight coupling is maintained.

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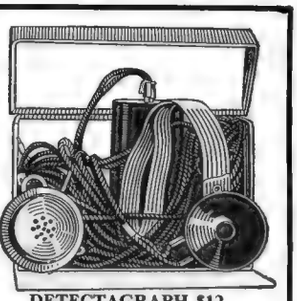

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Gaston Boissonnault, Pres. 119 Naussau St., N. Y. C.

No Experimenter Can Afford to Be Without the Big New **CHEMCRAFT**

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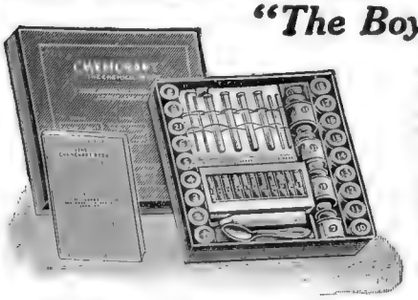

With this big Chemcraft outfit you can do countless experiments in Chemistry and Chemical Magic. You can work the chemical experiments now appearing in the Electrical Experimenter. ing ink— change water to wine and Chemical fire and Fir ndless number of other wo

Chemcraft co fully chosen for their many uses a s, all the necessary apparatus and with complete directions for 85 ex- planations of the various Chemcraft owner is eligible to Chemcraft service.

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Price $2.50 Postage paid in Continental United States and Canada. Foreign $3.00. Description sent on request.

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Write for Prices.

THE PORTER CHEMICAL COMPANY
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A GENUINE "RED DEVIL" GLASS CUTTER FOR 10c

FOR THE ELECTRICAL EXPERIMENTER'S TOOL KIT

The most useful tool for making and repairing glass plates for wireless condensers. Also a handy household tool for repairing picture frames, windowpanes, etc.

Write for free Glass Cutter Booklet.

Smith & Hemenway Co., Inc., 107 Chambers St., New York City

FOX TYPEWRITERS

Factory Rebuilt, Like New, at $52.50

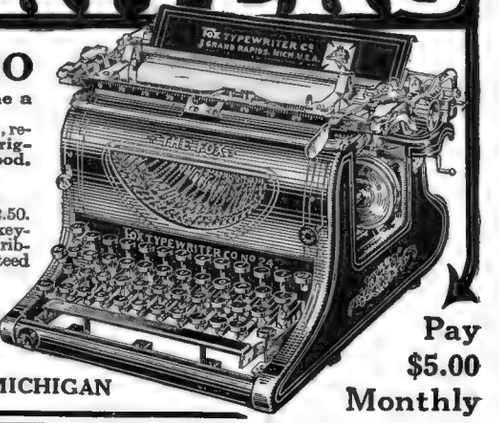
The word "rebuilt" has been abused and misused until it has become a meaningless trade term.

When we rebuild a Fox Typewriter we take it all to pieces, re-nickel the nickel parts, re-enamel the frame and replace all worn parts with new ones. **The same men who originally built the typewriter do this rebuilding and do the work just as good.**

40% New Parts and Three Years' Guarantee

We offer a rebuilt Fox Typewriter, Model No. 24—**just like new**—for $52.50. These have standard carriages, taking paper 10½ inches wide, any kind of keyboard, any kind of type, rubber covers, tabulators, back spacers, two-color ribbons, complete with instruction books and cleaning outfits, and are guaranteed for 3 years, the same as new ones, and to have not less than 40% of new parts.

Send any amount you can spare, **from $1 up**, as a first payment, and pay the balance $5.00 monthly. 5% discount for all cash. Purchaser must pay transportation. If $10.00 or more is sent with order we will include FREE a Fox Solid Oak Typewriter Table selling at $4.50. **Please order direct from this offer and inclose any amount you can spare**—and be sure and mention The Electrical Experimenter for March.



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MAGAZINE Prices Slashed

Millions of magazine subscriptions expire this month! With the tremendous advance of paper prices **it is certain that nearly all magazines will advance their subscription prices at least from 25% to 50%. BY ORDERING NOW YOU WILL SAVE BIG MONEY.**

In announcing these wonderful prices it is with the absolute knowledge that **our readers are offered the lowest prices for standard Magazines that it is possible to obtain anywhere.** Only by special arrangement with the publishers are these prices possible, but to take advantage of them, you must act quickly. **Don't delay, do it now.** This offer is so good that of necessity it must be limited in time. Just think of buying standard Magazines at reduced prices in time for Xmas Presents, and **they certainly make ideal gifts** being a constant reminder for a whole year of a considerate friend. Just glance over our wonderful prices, and see how **we enable one dollar to bring you two dollars' worth,** and then make up your list. When sending your order, don't forget to state **where magazines are to be sent. But be sure you do it now. To-morrow means you may forget** and lose this wonderful opportunity. All prices quoted are for subscribers in U. S. A. only, Canadian and Foreign subscriptions require additional postage.

The Publishers Will Mail the Magazine Direct From Their Own Office to You.

THIS OFFER WILL PROBABLY NOT BE MADE AGAIN!

Electrical Experimenter	$1.50	
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Electrical Experimenter	$1.50	
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Electrical Experimenter	$1.50	
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Electrical Experimenter	$1.50	
Boys' Magazine	1.00	Our Price
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Electrical Experimenter	$1.50	
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Electrical Experimenter	$1.50	
Delineator or Everybody's	1.50	Our Price
American or Musician	1.50	$3.25
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Electrical Experimenter	$1.50	
Youth's Companion	2.00	Our Price
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Special Clubbing Prices of Electrical Experimenter WITH:

	Regular price	Our rate per year
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Everybody's	3.00	2.30
Farm and Fireside	2.00	1.45
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Film Fun	2.50	1.80
Grit	3.50	2.80
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Judge Weekly	6.50	5.45
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Outing	4.50	3.45
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Pearson's Magazine	3.00	2.20
People's Popular Monthly	1.75	1.35
Popular Science Monthly	3.00	2.35
Puck	6.50	5.45
Red Book	3.00	2.30
Review of Reviews	4.50	2.95
Rural New Yorker	2.50	2.10
St. Nicholas	4.50	3.45
Scientific American	5.50	4.50
Scribner's Magazine	4.50	3.45
Smart Set	4.50	2.95
Wireless Age	3.00	2.20
Woman's Home Companion	3.00	2.30
World's Work	4.50	3.45
Youth's Companion	3.50	3.20

Write for Special Prices on ANY Publication not listed here.
We will save you money.

SEND ALL ORDERS TO "CIRCULATION DEPARTMENT"

Experimenter Publishing Co., Inc.

233 Fulton Street, New York City, N. Y.

Scientific Exchange Columns

UNDOUBTEDLY you have at the present time some things for which you have no further use. Do you wish to exchange them for something, for which you have immediate use? There is no surer and quicker way to do this than by advertising your articles in these columns. The *Very* people, the *Only* people, who could possibly have a use for your things read this journal. More than 75,000 interested people will see your ad. It is furthermore the cheapest advertising medium for you in the country. Dealers' advertising accepted in Opportunity Exchange Columns only.

The rates are: *Three cents per word* (name and address to be counted), minimum space 3 lines. Count about 7 words to the line. *Remittance must accompany all orders.* No advertisement for less than 50c. accepted.

We reserve to ourselves the right to refuse any advertisement which we consider misleading or objectionable. Advertisements for the March issue should reach us not later than January 25th.

The Classified Columns of "The Electrical Experimenter" Bring Positive Results.

Subscribers experiencing trouble in dealing with any advertiser should notify the publisher very promptly.

OVER 75,000 PEOPLE READ THIS JOURNAL

2,000 OHM Head Set for Sale. Price, $2. Jack Abrams, 512 W. 134th St., New York City.

FOR SALE OR EXCHANGE—$5 leather suit case, never used, sell $4; One $6.50 Gray Mackinaw, size 42, good condition, sell $4; $10 Eastman Kodak, 4x5, sell $7. Want raw materials, tools, wireless apparatus, or what have you? Martin Knox, Granite Falls, Minn.

NOTICE—Over $8.50 worth or over 225 copies of the Youth's Companion for $5. Magazines are in good condition. Will trade for raw materials, tools, wireless apparatus, or what have you? Address Martin Knox, Granite Falls, Minn.

BARGAIN—Wireless receiving set consisting of one double slide loose coupler, one fixed condenser, one loading coil, one silicon detector, and buzzer. Write for particulars. C. de W. Rogers, Jr., 17 Pryer Lane, Larchmont Manor, New York.

FOR SALE—Two Electron Relays at $4.50 each. One Audiotron at $3.50. If all bought, $10. 20 ft. ground wire at 5c. a foot. All new. George Dimon, 367 Genesee St., Utica, N.Y.

LOOSE COUPLER—$3; 2 loading coils, $2 each; key and sounder, $1.50; type "O" Crystaloi, $2.75; rotary printer, $2.50. Everything fine condition. Robert Weinig, Dover, Ohio.

WILL EXCHANGE—Wireless sending and receiving for printing press. W. Bowstead, 2950 Greenmount Ave., Baltimore, Md.

FOR SALE—2 Battery Motors, Reversing Switch, Acetylene Headlight, Electrolysis Outfit, new, cost $18. Will exchange for small 110-115 volt Direct Current Generator, Voltmeter, Ammeter, Watt-hour Meter, Water Motor, Polishing Lathe, Speed Counter. J. Sargena, 618 Luzerne Ave., W. Pittston, Pa.

TWIN INDIAN MOTORCYCLE for sale or exchange for Dynamos, Storage Batteries or Motors. Harold Hufnagle, Ray, Ind., Route 2.

EXCHANGE—1½-inch spark coil with interrupter for rotary gap and ⅛ h.p. motor for hot wire ammeter. R. F. Clark, 1312 Lebanon Ave., Pittsfield, Mass., c. o. R.F.D.

FOR SALE—Complete 1 K.W. Transmitter. Also Receiving Apparatus. R. B. McIntyre, Putnam, Conn.

FOR SALE OR EXCHANGE—$65 G. G. Conn Cornet, with case, mute, and instruction book; all in good condition. First good offer takes it. Arthur Osborn, Wenatchee, Wash.

FOR SALE—½ K.W. Electro Importing Co.'s 8050 Transformer, Gernsback Electrolytic Interrupter, and choke coil, all in perfect condition for $8. Chas. Cornutt, 2540 Garfield Ave., Terre Haute, Ind.

FOR SALE—Murdock coupler, cost $15. New. Sell for $8. Write for list. Woodward, Santa Barbara, Cal.

AUTOMATIC CHARGING Cut-out Wanted. For sale, typewriter, $25; small gasoline engine, $20; tap and dies, wire. Enclose stamp for reply. George Dietrich, 1911 Atkinson Ave., Milwaukee, Wis.

HAVE TRANSFORMER in cabinet with twelve point primary switch variable from one to three and one-half kilowatts, 9x9-inch helix wound with copper ribbon, spark gap with 1-inch zinc plugs, $50 or trade for 3 h.p. 220 volts, 60 cycle 3 phase motor. R. R. Ridgely, Rocky Ford, Colo.

FOR SALE—Two-thousand-mile Radio Receiving Station, including Brandes Phones, Blitzen Variable, etc. Get my attractive proposition. H. Yohe, Box 31, McSherrystown, Pa.

HAVE—3 watt meters A.C. and D.C.; one magneto, $12; Field Glasses, $6.50; hunting knife, new, $3. WANT—Pistols or Guns. Must be good brand and in good condition. Meters cost $34, $25, $13. Lowery Simmons, Van Alstyne, Texas.

FOR SALE OR EXCHANGE—For wireless or electrical goods, one set 10 volumes "Hawkin's Electrical Guides," good as new, also 7 jeweled Elgin watch, 25 year case. Want electrolytic interrupter, high frequency Tesla coil with condenser or X-ray apparatus. Hubert Yeager, Box 312, Ballinger, Texas.

RESULTS!

Matoon, Illinois.
November 21st, 1916.

Dear Sirs:

Got to give it to the "E. E." ads, as they sure are THERE when it comes to penetrative WORK..... and we are enclosing ANOTHER ad which please insert in the January issue of the Opportunity Exchange.

Yours very truly,

Mid-West Wireless Mfg. & Supply Co.

Try Them Yourself

FIRST $13 TAKES—Electro 1-inch coil; Tuner; Antenna Switch; Variable and Fixed Condensers; Key, leg type, Head Set 3,000 ohms. James Foreman, 558 Main Ave., Passaic, N.J.

FOR SALE—Two new complete fifty foot iron masts, sell separately, $5 each. Send stamp for photograph and description. J. Smith, Trout Run, Pa.

SELL—Sixty-volt hand drive Dynamo, $2.50; Half-inch Amco Spark Coil, $2; Crystaloi type A Detector, $1.75; Two telegraph sounders, 75c. each; Bosch DU4 High Tension Magneto, practically new, $15. Clarence Vaughan, Middletown, New York.

FOR SALE—Audion detector, Brandes fones, 1 inch spark coil, spark gap, storage battery, etc., at fair prices. Write for particulars. Le Roy Brown, Route 8, Hamilton, Ohio.

WHAT AM I OFFERED for a Trans-Pacific Receiving Outfit; 5,000 meter Loading Coil; 2,000 Ohm Double Pole Headset, 2 quart Leyden Jar; $5 Mesco Helix, A. Abele, 249 Eldert St., Brooklyn, N.Y.

WILL EXCHANGE a Keystone milliampermeter, excellent for radio and electrical measurements, for a rotary variable condenser, quenched spark gap, 60 cycle 110 V.A.C. motor or what have you? Have also a commercial type perikon detector; what do you offer for this high class instrument? Samuel Cohen, 1936 Pitkin Ave., Brooklyn, N.Y.

FOR SALE OR EXCHANGE—Pair Superiors, positively perfect condition, one month old, $4.92; 4-Bar Telephone Magneto, $3.50; Crystaloi O, $2.89; SPST 60 A 250 V switch, 85c.; Tillotson Sounder, $1.35; 6-inch 12-point rotary disk, $1; 10 Ampere Boston Key, never used, $5.70; 10 Ampere Hot-wire Ammeter, new, $10; "Radio" Navy Coupler, $19. All prepaid. Everyone answered. L. B. Stratton, Oneida, N.Y.

UNUSED pair Electro 3,000 ohm "Government" phones and one Electro Junior Fixed Condenser. Both for $6. Write to John Mrowca, 1269 Franklin St., Taylor, Pa.

WANTED—Small stationary gasoline engine, also foot-power lathe, state condition, make and best price first letter. Lewis Hagerman, 1127 Irving Place, Racine, Wis.

NEW—$14, 110 Direct Current Dynamo Motor for only $6.50. Clarence Kositzky, 911 South Ninth, Lincoln, Neb.

BARGAIN—Electrolytic Interrupter, $1.75, fine condition. J. Walter Moore, El Dorado, Ark.

FOR SALE—One pair Brandes Receivers, $3.75; one E. I. Co.'s Loading Coil, $1.75; one 4-ohm Telegraph Set, $1; three Telephone Inductance Coils, 30c. each; one Loose Coupler, $3.75; one E. I. Co.'s Detector, $1.50; one Secondary Coil for 1½ inches, 70c.; one Vibrator for 2-inch coil, $1.25; one Plug Switch, 35c.; one Primary for 1½-inch coil, 50c.; one Condenser for same, 35c.; one Junior Condenser, 35c.; one 8½-inch Flashlight Case, 30c.; one Spark Gap, 35c. Roy Ward, Bardstown Junction, Ky.

FOR SALE—½ K.W. Blitzen type low voltage transformer suitable for rotary quenched gap, price $9. M. L. Hodgdon, 24 Wachusett St., Worcester, Mass.

$6.50 TAKES Wireless Receiving Outfit, Spark Coil, Geissler Tube, Push Button, Double Pole Switch, Small Camera, Books. Max Vineski, Troy, Pa.

BAUSCH & LOMB HOME BALOPTICON for latern slides or opaque pictures, complete with 45 degree arc lamp, rheostat and large aluminum screen. Brand new. Cost $45. Will sell for $35. Hodgins, Box 387, Moscow, Idaho.

FOR SALE—Loading coil, $1; 500 meter coupler, $6.50; 4,000 meter coupler, $10; condenser, 40c.; Blitzen wave meter, $7.50; 1,000 ohm receiver, 90c. All letters answered. Carl Crane, Homer, Mich.

COMPLETE WIRELESS SET with receiving range of NAA, NAJ, NAT, WME, etc. First reasonable offer takes it. Write soon. Leo Niedzielski, 1215 23rd St., Bay City, Mich.

FOR SALE—One Edgcomb-Pyle receiving set, cost $72, will sell for $35, and one Transcontinental receiving set, cost, $25, will sell for $16. Ed. B. Fanske, Jeweler. Pierce, Neb.

FOR SALE—75 Watt Dynamo, $8. Duck's ½ K.W. Transformer, $5; Electrolytic Interrupter, $1.50; Voltmeter, $1.50; Ammeter, $1.50; Sending Condenser, 75c.; Receiving Condenser, 35c.; Large Spark Gap, 75c.; One Minute Camera with supplies, $2; Static Machine less condensers, $2; Key, 75c. Budi Hartmann, 73 Liberty St., Meriden, Conn.

FOR SALE—One pair Holtzer Cabot 3,000 ohm phones, $6. H. Sutton, 10 Avon Street, Roselle Park, N.J.

BARGAINS—Auto ⅜ inch spark coils, 75c.; double pole 1,000 ohm receiver, 75c.; receiving condensers, 30c. Enos Johnston, 9 Rutherford St., Binghamton, N.Y.

EXCHANGE—Loader, double slide tuner, detector, shot gun, repeating rifle, sounder, etc. Want key. All letters answered. Lester Fawcett, Independence, Iowa.

WANTED—A two-speed Henderson or Harley hub for motorcycle. State condition and price when writing. Orman Bell, Brunswick, Md.

FOR SALE—1½-inch spark coil; 1½-pt. Leyden Jar; No. 2 Brownie Camera; No. 4 Mecanno; 2000-meter Loose Coupler. J. Isenberg, 1126 Sixteenth Avenue, Altoona, Pa.

WANTED—220 D.C. used motors and small generators. Write me. Leon Neligh, Hope, Ind.

FOR SALE—Complete tuning cabinet, enclosed with bakelite front, double primary switches nine point secondary, and loader, tunes to 6000 meters, $16.50, complete mounted receiving set, 2500 meter transformer, two detectors, perikon and single crystal and condenser $20.00, an $18.00 Cabot interrupter spark coil, $8.50. Weaver W. Adams, Dedham, Mass.

Opportunity Exchange

YOU will probably find more opportunities and real bargains in these columns than anywhere else in the country. Most good things in life are hard to find and worth going after—these little ads illustrate that point; you alone will be the real loser if you don't take the time to scan through these columns.

Advertisements in this section 4c. a word for each insertion. Count 7 words per line.

Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent. discount for 6 issues, 20 per cent. discount for 12 issues from above rate. Objectionable or misleading advertisements not accepted.

Advertisements for the March issue should reach us not later than January 25.

OVER 75,000 PEOPLE READ THIS JOURNAL

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N.Y.

BOOKS

HAVE YOU SEEN A COPY?—Amateur Photographer's Weekly, $1.50 per year; weekly prize competitions; criticisms; print exchange; illustrated; many features. Three months' subscription 40c. Amateur Photographers' Weekly, 915 Schofield Bldg., Cleveland, Ohio.

BOOKS—Scientific and wireless supplied. Let us know what you want and we will quote you. Experimenter Pub. Co., 233 Fulton St., New York City.

A BINDER for THE ELECTRICAL EXPERIMENTER will preserve your copies for all time. Price 50c. Postage on 3 lbs. is extra. Send for one to-day. Experimenter Pub. Co., 233 Fulton St., New York City.

HELP WANTED

WANTED MEN AND WOMEN, 18 or over, everywhere, for U. S. Government Life Jobs. Thousands 1917 Vacancies. $75.00 month. Steady work. Short hours. Rapid advancement. Common education sufficient. Write immediately for list of positions easily obtainable. Franklin Institute, Dept. T-29, Rochester, N.Y.

MISCELLANEOUS

EVERYBODY WANTS IT.—Folding pocket Coat and Hat Holder. Can attach anywhere and remove instantly, nickel-plated. Sample 10c. Big seller for agents. Wedge Mfg. Co., "Km," Binghamton, N.Y.

LEARN SHOW CARD Lettering and Sign Painting by our quick, low-priced method and be independent. Earn from $18 to $50 per week. The most interesting and best paying trade in the country. Useful in any line. Full particulars free. Providence School of Lettering, 21 East St., Providence, R.I.

STAMPS—75, all different, free. Postage 2c. Mention paper. Quaker Stamp Co., Toledo, Ohio.

MARCONI—We have a limited number of pictures of Guglielmo Marconi, De Forest and Steinmetz that are done in sepia on fine India paper. Fine for decorating your wireless room. Ten cents each postpaid. Experimenter Publishing Co., 233 Fulton St., New York.

PATENT ATTORNEYS

PATENTS—Without advance attorney's fees. Not due until patent allowed. Send sketch for free report. Books free. Frank Fuller, Washington, D.C.

PATENTS ON EASY PAYMENTS—Send sketch for free opinion as to patentability. Write to-day for our new book on what to invent and how to protect your invention under our new easy payment plan. C. C. Hines & Co., 593 Victor Bldg., Washington, D.C.

IDEAS WANTED—Manufacturers are writing for patents procured through me. Three books with list of hundreds of inventions wanted sent free. I help you market your invention. Advice free. R. B. Owen, 130 Owen Bldg., Washington, D.C.

JOHN M. McLACHLEN, Attorney-at-Law—Patent causes. Union Trust Bldg., Washington, D.C.

PATENTS—Personal attention to all inquiries. No printed literature. No lists of "Inventions Wanted"—such being unauthorized by the Patent Office. Fees reasonable, consistent with best results obtainable. Electrical and Mechanical Expert. Established 1849. J. Edward Bangs, Suite 408, Barrister Bldg., Washington, D.C.

AMERICAN AND FOREIGN PATENTS obtained. Before selecting an attorney write for our solid, instructive advice; join the ranks of happy inventors. Correspondence Office, 125 East 23rd Street, New York City. F. V. Winters, Reg. Patent Lawyer, New York City, and Washington, D.C.

Your Ad Here Will Pay Profits

That's one reason, there are others; but that one is sufficient.

Your ad to be inserted in the March issue must be in our office before January 25

TYPEWRITERS

TYPEWRITERS—Any make $10 and up. $25 to $50 saved. Rebuilt at the factory by the well-known "Young Process"—looks and wears like new. Our large and interesting business enables us to sell or rent at sharp cut price; terms if desired. We will ship anywhere any make machine you want and guarantee satisfaction. Write for detail information. Address Young Typewriter Co., Dept. 1348, Chicago.

WIRELESS

AUDION—New round two filament De Forest Audion Bulbs for $6.50. Cahn, 746 Greene Ave., Brooklyn, N.Y.

EXPERIMENTAL WORK and Apparatus made to order. Have small lathe, take anything in exchange or give lowest price. J. F. Young, 1938 Federal St., Philadelphia, Pa.

RADIOGRAMS—For copying down wireless messages. Eight styles. Size 4x7 inches. Price 5c. per pad of 100 sheets; 50c. per dozen. Send for free samples. Moulton Printing Company, 2323 Tennessee Ave., St. Louis, Mo.

HIGH VOLTAGE TRANSFORMERS—Have ten, 150 watt, 110-10,000 volt, closed core transformers. Designed for continuous duty on ozone machines, but small, easily constructed, resistance needed for wireless work. Will close out at less than half manufacturing cost. $5.50 each, F.O.B. Bay City, Mich. Full instructions. Address all communications to L. Trumble, 501 S. Johnston St., Ada, Ohio.

LET ME MOUNT that instrument on polished, white marble base. Clarence Kositzky, 911 South 9th St., Lincoln, Neb.

TELEGRAPHY—Morse and Wireless—also Station Agency taught. Graduates assisted. Cheap expense—easily learned. Largest school—established 42 years. Correspondence courses also. Catalog free. Dodge's Institute, Lone St., Valparaiso, Ind.

QST

IF YOU wish to save MONEY when purchasing wireless apparatus, write for my price on the instrument in which interested before placing your order elsewhere. I have Brandes, Bunnell, Clapp-Eastham, Colby, De Forest, Electro-set, Holtzer-Cabot, Blitzen, Lenzite, Mignon, Multi-Audi-Fone, Murdock, Packard, "Radio," Richardson Company, Thordarson, Turney, etc., apparatus. Marko Batteries, Knapp Motors, Hawkins' Guides. Let me quote you. Please enclose stamp. Brainerd Stratton, Oneida, N.Y.

FOR SALE

LIMITED NUMBER well-known make ¼-inch spark coils—genuine platinum contacts—surface contact binding posts—excellent for wireless—money back guarantee—weight four pounds. Price $1.35 each. L. R. Jewett, 20 Schussler Rd., Worcester, Mass.

WAIT!—Multi-Audi-Fones, $15.30; Mignon RBD8 cabinet, $31.90; H. C. fones, $7.95. Write now. Western Wireless Supply Co., 425 Davidson St., Indianapolis, Ind.

SAVE MONEY on your wireless purchases! Efficient equipment for college, school, and private installations. All leading makes of radio apparatus at money saving prices. Write your wants and ask for new catalog of QUALITY apparatus. Arthur B. Church, 113 Welch St., Ames, Iowa.

RECEIVING SET $7.50, with 2000 ohm Murdock Phones. Best $1.00 Cat whisker detector made. Photo for two cent stamp. High frequency buzzers, 50c. Anything from a binding post to a 1 K.W. set. Nine years radio experience. Get on my mailing list. Jenkins, 74 Smith St., New Bedford, Mass.

MURDOCK No. 55

The real test of the true worth of these 'phones is a trial in YOUR station. We are willing to accept YOUR judgment.

The biggest value in the world. They possess every desirable quality necessary for permanent, super-sensitive operation.

2000 OHM COMPLETE DOUBLE SET $4.00

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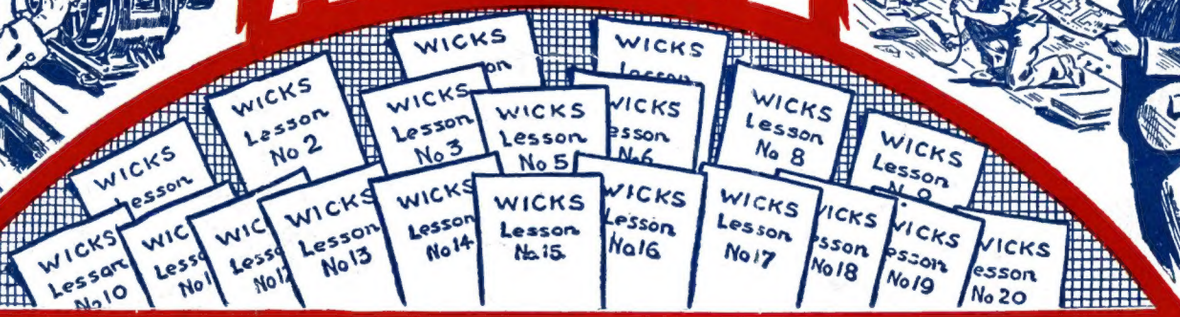
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